Comments for Draft Revisions *(Not Applicable to Directives; Refer to Directive Management Officer for Directive Comment Format)*

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Comments Submitted By:	Norm Pereira, AIR-130 Branch, Section 133
Organization:	Dukane Seacom (1), Sierra Nevada Corp. (2-6), Robinson Helicopter Co. (7-41), The Boeing Company (42-72), Underwriters Laboratories Inc. (73-86)
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#	Document Name	Page Number	Paragraph Number	Referenced Text	Comment/Rationale or Question	Proposed Resolution	Comment Type (Conceptual, Editorial, or Format)	Disposition/Response to Comment
1	AC20-184	1-2	1.3.1.2	Cockpit voice recorders, flight data recorders, and underwater locator beacons;	Per TSO-C121b, Underwater Locator Beacons are self-powered and used primary batteries. These do not apply to this AC, but rather TSO-C142a and DO-227	Cockpit voice recorders~~,~~ and flight data recorders~~, and underwater locator beacons;~~	Conceptual	Agree - This AC is intended for rechargeable lithium battery on aircraft. TSO-C142a is for non-rechargeablelithium batteries and does not apply to this AC.

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2	Guidance on Testing and Installatin of Recharrgeable Lithium Battery and Battery Systems on Aircraft.	1-3	1.4.2.3	Unlike nickel-cadmium and lead-acid batteries, some types of lithium batteries use liquid electrolytes that are flammable.	Most out-gassing of both nickel-cadmium and lead-acid batteries are flammable, just like a lithium battery. Therefore they ALL have the ability and potential to feed a flame.	Delete the editiorial statement "Unlike nickel-cadmium and lead-acid batteries," as it really does not add any technical or comfort justification to the content of the paragraph.	Editorial	Disagree - The subject of this paragraph is to highlight the flammable elctrolyte and not the out gassing features.
3	Guidance on Testing and Installatin of Recharrgeable Lithium Battery and Battery Systems on Aircraft.	2-2	Table 1	§23/25/27/29.785	Why is this regulation included here? It does not appear to have anything to do with batteries.	Remove this regulation from the table.	Conceptual	Disagree - This regulation is applicable since xx.785 may have seat belts that include lithium batteries.
4	Guidance on Testing and Installatin of Recharrgeable Lithium Battery and Battery Systems on Aircraft.	2-8	2.9.8	"Replacement of individual cells within lithium batteries must be approved by the lithium battery's OEM and the FAA."	Will this be a separate FAA approval outside of the ICA approval? If not, what is expected to get this?	Add guidance on how to obtain approval for replacement of individual battery cell if it is outside of FAA ICA approval.	Conceptual	Disagree - This evaluation is accomplished on a case by case basis and approved by the FAA.
5	Guidance on Testing and Installatin of Recharrgeable Lithium Battery and Battery Systems on Aircraft.	3-1	3.2.4	"Determine the state of health of the lithium battery by recording the following:"	Is there a specific location this information should be recorded? Or is that up to the installer/operator?	Clarify where this information should be recorded as required.	Editorial	Disagree - Where and how this information is recorded is based on the battery system design.
6	Guidance on Testing and Installatin of Recharrgeable Lithium Battery and Battery Systems on Aircraft.	D-4	SC Req #9	ICA	Why is this listed in the special condition? It is repetive of the requirements for 2x.1529. While 2x.1529 does not specifically call out litium batteries, all the information listed for the special condition is expected of an ICA for any system or component. It would be redundant for a certification basis to have ICA compliance to the CFRs and the SC.	Remove this special condition requirement.	Conceptual	Disagree - The SC #9 is part of the published special conditions in the the NPRM. They are stated as typical special conditions and will be addressed by the applicable directorates and aircraft certification offices.

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7	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	All	0 General		The Advisory Circular provides guidance on the general certification process. While this information may be useful to applicants unfamiliar with the process, it is available elsewhere such as "*The FAA and Industry Guide to Product Certification*" and FAA Order 8110.4C "*Type Certification*". The Advisory Circular could be shortened and simplified by focusing only on guidance specific to lithium batteries.	Recommend deleting sections 2.1 and 2.2 and replacing with brief reference to availability of 8110.4C and "The FAA and Industry Guide to Product Certification" in introduction.	Conceptual	Disagree - The AC is a guidance document for the means of compliance for installed rechargeable lithium battery and battery system on aircraft. All other certification procedures are also applicable.
8	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	All	0 General		The Advisory Circular implies that Special Conditions will be applied to all lithium battery installations, regardless of scope or complexity, now and in the future. Per 14 CFR 21.16, Special Conditions are only published when the FAA finds that the airworthiness regulations do not contain adequate or appropriate safety standards because of a novel or unusual design feature. Special Conditions as part of a certification project substantially increase the administrative burden on both the applicant and FAA and are not an efficient methodology for numerous, related projects. The advantages of lithium batteries make it likely that they will become industry standard in the near future. Using Special Conditions as a blanket, long-term solution does not seem appropriate. A careful review of existing regulations shows that the regulations already adequately address many of the items proposed as Special Conditions. For any areas which are lacking, Special Conditions should be tailored to individual projects and used only until the regulations can be revised.	Recommend deleting Appendix D and references to it.	Conceptual	Disagree - The SC is part of the published NPRM special condition on the Federal Register. They are stated as typical special conditions and will be addressed by the applicable directorates and aircraft certification offices.

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9	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	All	0 General		Throughout the AC the term "must meet" is used. Advisory circulars are advisory in nature. For product certification ACs they provide a means, but not the only means, of demonstrating compliance. The language throughout the AC should be updated to make this clear.	Recommend replacing "must" with "should" throughout document.	Conceptual	Disagree - If you follow the AC you must follow it in its entirety.You may suggest an alternate means of compliance with the ACO.
10	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	All	0 General		The existence of TSO C179a is only listed under "Other" in *Appendix B, Related Regulations and Documents* and is not mentioned at all in the main body of the AC. However it features prominently in the *Lithium Battery Means of Compliance Certification Process Flow Chart* of Appendix G. The importance of the TSO and how it simplifies the compliance requirements should be expanded on in the main body of the AC.	Recommend adding references to TSO C179a in Chapter 2 and detail differences in installation compliance requirements for batteries with and without TSO C179a approval.	Editorial	Noted -Regardless of an article having a TSO or not having a TSO, the airworthiness regulations of the product must be met.This recommendation is addressed by other certifications documents.
11	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	All	0 General		The advisory circular (AC) provides guidance for maintenance and operational considerations (14 CFR Parts 43, 91, and possibly other Parts) as well as product certification considerations (14 CFR Parts 23, 25, 27, and 29). Traditionally, operations and maintenance ACs would be separate from certification ACs. A tie-in to applicable regulations is provided for the product certification portion of the AC, but no regulatory references are provided for operation and maintenance.	Recommend creating separate AC for information included in Chapter 3.	Conceptual	Disagree- Out of scope of this AC.

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12	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	All	0 General		The AC is not organized to facilitate associating specific guidance with applicable regulations. A more helpful format would be to list applicable regulations with specific guidance for each, e.g. "xx.1309(a) An acceptable means for meeting environmental qualification requirements is . . ."	Recommend reorganizing AC to provide guidance by regulation.	Editorial	Disagree- This AC is organized to provide a comprehensive guidance associated with showing compliance to the special conditions with respect to installed rechargeable lithium battery and battery system on aircraft.
13	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	ii	TABLE OF CONTENTS		APPENDIX G is actually the *Lithium Bat*	Correct reference to Appendix G and add Appendix H in table of contents.	Editorial	Agree - Document Updated
14	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	1-2	1.3.1	"Because of their high energy content and potential thermal instability, lithium batteries can present hazards. . ."	The AC contains the language "Because of their high energy content and potential thermal instability, lithium batteries can present hazards. . .". Any battery, depending on size, can have high energy content (lithium batteries have high energy density as stated in the previous sentence of paragraph 1.3.1) and many battery chemistries (e.g. NiCad) may exhibit thermal instability.	Recommend clarifying lithium battery-specific issues and providing details of what distinguishes lithium from other battery chemistries.	Conceptual	Agree - Clarification added to the document.
15	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	1-3	1.4.2.2		Many common battery chemistries suffer similar detrimental effects due to over discharge. The AC does not distinguish whether lithium batteries (or particular lithium chemistries) are more susceptible than other types of batteries.	Recommend clarifying how lithium battery issues differ from other battery chemistries.	Conceptual	Disagree - Further classification of different types of batteries are out of scope of this document.

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16	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	1-3	1.4.2.4		This paragraph would be applicable to any battery chemistry. Undetected internal defects leading to an unsafe condition would be applicable to any part or piece of equipment. This paragraph appears to provide guidance on general quality assurance practices rather than on issues specific to lithium batteries.	Recommend removing or rewording this paragraph.	Conceptual	Disagree - Internal defects have been shown to be an issue on lithium battery.
17	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	2-1	2.1		This paragraph provides the general certification process for all products. It will be followed as a matter of course does not add value to the AC. Recommend removing this paragraph.	Recommend removing this paragraph.	Conceptual	Disagree - The AC is a guidance document for the means of compliance for installed rechargeable lithium battery and battery system on aircraft. All other certification procedures are also applicable
18	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	2-1	2.2.1 and its subparagraphs		These paragraphs describe general certification procedures for all products and do not indicate anything other than standard procedures for lithium batteries. They do not add value to the AC. In addition, some simple projects may not require all elements in their certification plans. Certification plans must be tailored to individual projects. Recommend removing 2.2.1 and its subparagraphs.	Recommend removing 2.2.1 and its subparagraphs.	Conceptual	Disagree - The AC is a guidance document for the means of compliance for installed rechargeable lithium battery and battery system on aircraft. All other certification procedures are also applicable

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19	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	2-1 through 2-3	2.2.2.1	"These installations shall also meet the guidance in this chapter and the airworthiness regulations in Table 1 at a minimum."	This paragraph gives compliance checklist guidance and states "These installations shall also meet the guidance in this chapter and the airworthiness regulations in Table 1 at a minimum." Not all of the regulations in Table 1 would be associated with all projects. Compliance checklists must be tailored to individual projects. Suggested rewording: "A list of the most relevant regulations to consider when preparing a compliance checklist for a lithium battery project is provided in Table 1. Additional or fewer regulations may apply depending on the scope of the project."	Suggested rewording: "A list of the most relevant regulations to consider when preparing a compliance checklist for a lithium battery project is provided in Table 1. Additional or fewer regulations may apply depending on the scope of the project."	Conceptual	Disagree - This AC provides a comprehensive guidance for all installed rechargeable lithium batteries on aircraft and therefore reference to all applicable CFR's are appropriate.Relevant regulations for a specific lithium battery project will be determined by the FAA.
20	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	2-3	2.2.2.1	"14 CFR 23/25/27 and 29.1353 do not address lithium battery installation."	The statement after Table 1, "14 CFR 23	Suggested rewording " . . . (f) and (g) at present only address nickel cadmium batteries. Provisions for equivalent protection and monitoring should be made for lithium batteries."	Conceptual	Agree with modification- Clarified the AC to note that the current regulations do not adequately address lithium battery installations.
21	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	2-4	2.3.1.1 and its subparagraphs	"Lithium battery systems on aircraft must meet environmental qualification standards in:"	"Lithium battery systems on aircraft must meet environmental qualification standards in:" should be reworded to "One acceptable set of environmental qualification standards for lithium battery systems on aircraft are those found in:"	"One acceptable set of environmental qualification standards for lithium battery systems on aircraft are those found in:"	Conceptual	Disagree- DO-160 is an acceptable means of environmental test. An alternate means of environmental tests can be negotiated out with the ACO.

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22	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	2-4 and 2-5	2.3.3 and its subparagraphs		These paragraphs describe basic "intended function" ground and flight tests that occur during the installation approval process for any piece of equipment. There is nothing special here for lithium batteries. Recommend removing these paragraphs.	Recommend removing these paragraphs.	Conceptual	Disagree- The guidance material in this section of the AC is in harmony with the FAA certification process.
23	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	2-5	2.4.1.3	"No interference due to any failures of the lithium batteries"	The statement "No interference due to any failures of the lithium batteries" is too absolute. One can always conceive of some sort of failure that could produce some "interference". The key elements are the probability of a specific failure and the effects/severity of the failure.	Recommend deleting this sub-paragraph.	Conceptual	Disagree - This assessment could be required for the development of Faukt Tree Analysis and completion of System Safety Assessment.
24	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	2-5	2.4.1.7		This paragraph is redundant to the last sentence of paragraph 2.4.1.	Recommend deleting this sub-paragraph.	Editorial	Disagree - They are not redundant.
25	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	2-5	2.4.1.8	"Statement of compliance for each requirement"	"Statement of compliance for each requirement" does not sound like information typically found in a System Safety Assessment. The SSA would provide some but not necessarily all of the data supporting a statement of compliance.	Recommend deleting this sub-paragraph.	Conceptual	Disagree - This sub paragraph is part of the main SSA paragraph and is only meant to be applicable to compliance issues identified in the SSA.

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26	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	2-8	2.9.6.3		This paragraph appears to be the equivalent of periodic specific gravity checks for lead acid batteries. Is there an equivalent for lithium batteries?		Conceptual	Disagree - The paragraph is appropriately worded for this AC.
27	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	2-8	2.9.6.5		Is there a "visual" check for battery and charger degradation? Is a battery charger considered part of the aircraft/ICA?		Conceptual	Disagree- This evaluation is based on a specific installation.
28	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	2-8	2.9.7		Instructions for spares storage should be created by the battery manufacturer and implemented at the storage facility level. They may be beyond the scope of an airframe ICA document.	Recommend deleting this sub-paragraph.	Conceptual	Disagree- The paragraph is appropriately worded for this AC.
29	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	3-1	3.2.3	". . .restores a battery to full charge during a flight of 1 hour to 90 minutes regardless of use before flight."	". . .restores a battery to full charge during a flight of 1 hour to 90 minutes regardless of use before flight." should not be made as a general statement. Recharge times vary with battery chemistry and charging system and therefore times may be longer or shorter. Excessive use before flight may discharge the battery far enough to preclude normal charging.". . .restores a battery to full charge during a flight of 1 hour to 90 minutes regardless of use before flight."	Recommend deleting this sub-paragraph.	Conceptual	Agree- Document updated.

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30	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	3-1	3.2.4 and its subparagraphs	"determine the state of health"	While the items listed in 3.2.4.1 through 3.2.4.3 may provide circumstantial evidence about battery condition, they do not "determine the state of health".	Recommend deleting this sub-paragraph.	Conceptual	Disagree- The paragraph is appropriately worded for this AC.
31	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	3-3 and 3-4	3.4 and its subparagraphs		These are depot-level instructions for handling and maintenance of uninstalled batteries in storage. They are not directly related to "Testing and Installation" of lithium batteries in aircraft as indicated by the AC title. Recommend providing this information in a different document.	Recommend providing this information in a different document.	Conceptual	Disagree- This section is for storage and handling of spares for a specific battery installation on an aircraft.The paragraph is appropriately worded for this AC.
32	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	D-1	APPENDIX D	"Safe cell temperatures and pressures must be maintained during any foreseeable charging or discharging condition and during any failure of the charging or battery monitoring system. . ."	"Safe cell temperatures and pressures must be maintained during any foreseeable charging or discharging condition and during any failure of the charging or battery monitoring system. . ." duplicates 14 CFR 27.1353(b) (and, presumably the xx.1353 for other aircraft categories). It is not necessary to make it a special condition. The same numeric value for prescribed failure probability is applied to all Parts (23, 25, 27, and 29). This is inconsistent with current policy and guidance for failure probabilities and xx.1309 requirements.	No Special Condition Required	Conceptual	Disagree- 14 CFR 23/25/27 and 29.1353 do not adequately address lithium battery installation

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33	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	D-1	APPENDIX D	"Design of the rechargeable lithium batteries must preclude the occurrence of self-sustaining, uncontrolled increases in temperature or pressure."	"Design of the rechargeable lithium batteries must preclude the occurrence of self-sustaining, uncontrolled increases in temperature or pressure." is adequately addressed by 14 CFR 27.1353(b) (and, presumably the xx.1353 for other aircraft categories). It is not necessary to make it a special condition. The same numeric value for prescribed failure probability is applied to all Parts (23, 25, 27, and 29). This is inconsistent with current policy and guidance for failure probabilities and xx.1309 requirements.	No Special Condition Required	Conceptual	Disagree- 14 CFR 23/25/27 and 29.1353 do not adequately address lithium battery installation
34	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	D-1 and D-2	APPENDIX D	"No explosive or toxic gases emitted by any rechargeable lithium battery in normal operation, or as the result of any failure of the battery charging system, monitoring system, or battery installation which is not shown to be extremely remote, may accumulate in hazardous quantities within the aircraft."	"No explosive or toxic gases emitted by any rechargeable lithium battery in normal operation, or as the result of any failure of the battery charging system, monitoring system, or battery installation which is not shown to be extremely remote, may accumulate in hazardous quantities within the aircraft." is adequately addressed by 14 CFR 27.1353(d) (and, presumably the xx.1353 for other aircraft categories). It is not necessary to make it a special condition. The same numeric value for prescribed failure probability is applied to all Parts (23, 25, 27, and 29). This is inconsistent with current policy and guidance for failure probabilities and xx.1309 requirements.	No Special Condition Required	Conceptual	Disagree- 14 CFR 23/25/27 and 29.1353 do not adequately address lithium battery installation

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35	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	D-2	APPENDIX D	"Installations of rechargeable lithium batteries must meet the requirements of Title 14 of the Code of Federal Regulations (14 CFR) 23/25/27/29.863(a) through (d) for parts 23, 25, 27, and 29."	"Installations of rechargeable lithium batteries must meet the requirements of Title 14 of the Code of Federal Regulations (14 CFR) 23/25/27/29.863(a) through (d) for parts 23, 25, 27, and 29." It is not necessary to make compliance with an existing regulation a special condition.	No Special Condition Required	Conceptual	Disagree- 14 CFR 23/25/27 and 29.1353 do not adequately address lithium battery installation
36	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	D-2 and D-3	APPENDIX D	"No corrosive fluids or gases that may escape from any rechargeable lithium battery may damage surrounding structure or any adjacent systems, equipment, or electrical wiring of the rotorcraft in such a way as to cause a major or more severe failure condition, in accordance with § 27.1309(b) and (c), and applicable regulatory guidance.."	"No corrosive fluids or gases that may escape from any rechargeable lithium battery may damage surrounding structure or any adjacent systems, equipment, or electrical wiring of the rotorcraft in such a way as to cause a major or more severe failure condition, in accordance with § 27.1309(b) and (c), and applicable regulatory guidance.." is adequately addressed by 14 CFR 27.1353(e). It is not necessary to make it a special condition.	No Special Condition Required	Conceptual	Disagree- 14 CFR 23/25/27 and 29.1353 do not adequately address lithium battery installation
37	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	D-3	APPENDIX D	"Each rechargeable lithium battery installation must have provisions to prevent any hazardous effect on structure or essential systems caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells."	"Each rechargeable lithium battery installation must have provisions to prevent any hazardous effect on structure or essential systems caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells." 14 CFR 27.1353 (f) (and, presumably the xx.1353 for other aircraft categories) already makes this statement for NiCad batteries. A simple revision to include lithium batteries would be more expedient than employing a special condition for each lithium battery project.	Revise regulation so that (f) is not limited to NiCad	Conceptual	Disagree- The revision to the regulations will be made to include these special conditions.

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38	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	D-3	APPENDIX D	"The lithium battery system must have a capability to control the charging rate of the battery automatically, so as to prevent battery overheating or overcharging, and either— (i) A battery temperature sensing and over-temperature warning system with a means for automatically disconnecting the battery from its charging source in the event of an over temperature condition, or (ii) A battery failure sensing and warning system with a means for automatically disconnecting the battery from its charging source in the event of battery failure."	"The lithium battery system must have a capability to control the charging rate of the battery automatically, so as to prevent battery overheating or overcharging, and either— (i) A battery temperature sensing and over-temperature warning system with a means for automatically disconnecting the battery from its charging source in the event of an over temperature condition, or (ii) A battery failure sensing and warning system with a means for automatically disconnecting the battery from its charging source in the event of battery failure." 14 CFR 27.1353(g) (and, presumably the xx.1353 for other aircraft categories) already addresses this for NiCad batteries. A simple revision to include lithium batteries would be more expedient than employing a special condition for each lithium battery project.	Revise regulation so that (g) is not limited to NiCad	Conceptual	Disagree- The revision to the regulations will be made to include these special conditions.

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39	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	D-3 and D-4	APPENDIX D	"Any rechargeable lithium battery installation, the function of which is required for safe operation of the aircraft, must incorporate a monitoring and warning feature that will provide an indication to the appropriate flight crewmembers whenever the state-of-charge of the batteries has fallen below levels considered acceptable for dispatch of the aircraft."	"Any rechargeable lithium battery installation, the function of which is required for safe operation of the aircraft, must incorporate a monitoring and warning feature that will provide an indication to the appropriate flight crewmembers whenever the state-of-charge of the batteries has fallen below levels considered acceptable for dispatch of the aircraft." This would be one means, but not the only means, of demonstrating compliance with 27.1309 (or xx.1309 for other aircraft categories). Since lithium batteries are only one of many possible pieces of equipment required for safe operation, they could be considered under 27.1309 without a special condition.	No Special Condition Required	Conceptual	Disagree- 14 CFR 23/25/27 and 29.1353 do not adequately address lithium battery installation

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40	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	D-4	APPENDIX D	"The instructions for continued airworthiness required by §§ 23/25/27/29.1529 must contain maintenance requirements to assure that the battery is sufficiently charged at appropriate intervals specified by the battery manufacturer and the equipment manufacturer that contain the rechargeable lithium battery or rechargeable lithium battery system." "The instructions for continued airworthiness must also contain procedures for the maintenance of batteries in spares storage to prevent the replacement of batteries with batteries that have experienced degraded charge retention ability or other damage due to prolonged storage at a low state of charge."	"The instructions for continued airworthiness required by §§ 23/25/27/29.1529 must contain maintenance requirements to assure that the battery is sufficiently charged at appropriate intervals specified by the battery manufacturer and the equipment manufacturer that contain the rechargeable lithium battery or rechargeable lithium battery system." For 14 CFR Part 27, this requirement is already addressed by Appendix A. It is not necessary to make it a special condition. "The instructions for continued airworthiness must also contain procedures for the maintenance of batteries in spares storage to prevent the replacement of batteries with batteries that have experienced degraded charge retention ability or other damage due to prolonged storage at a low state of charge." This statement should apply to all battery chemistries. Depot level storage instructions may be beyond the scope of an airframe level ICA document.	No Special Condition Required	Conceptual	Disagree- 14 CFR 23/25/27 and 29.1353 do not adequately address lithium battery installation
41	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	G-1	APPENDIX G	"sub-assembly" and "Top Level Assembly" "Acceptable to be evaluated for installation"	Definitions for "sub-assembly" and "Top Level Assembly" should be provided "Acceptable to be evaluated for installation" should be clarified. Any equipment may be "evaluated" for installation. Some equipment will be quickly rejected as inappropriate for installation if it does not meet minimum safety and reliability standards.	Recommend adding definition of "sub-assembly" and "top level assembly" and clarify "acceptable to be evaluated for installation".	Conceptual	Disagree - These concepts are common to the aviation industry.

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42	FAA proposed AC 20-184x	1st page	1st paragraph after Subject	The proposed text states: This advisory circular (AC) provides manufacturers and installers an acceptable means of compliance to meet the installation, operation, maintenance and airworthiness requirements for installation of lithium batteries on aircraft (14 CFR part 21, 23, 25, 27 and 29).	grammar	We proposed adding the word "***with***" the text to be revised as follows: This advisory circular (AC) provides manufacturers and installers ***with*** an acceptable means of compliance to meet the installation, operation, maintenance and airworthiness requirements for installation of lithium batteries on aircraft (14 CFR part 21, 23, 25, 27 and 29).	Editorial	Agree - Document updated.
43	FAA proposed AC 20-184x	1-1	section 1.1.1	The proposed text states: 1.1.1 This AC provides an acceptable means to show compliance to the airworthiness requirements for installed rechargeable lithium battery and battery systems on aircraft as described in RTCA, Inc., documents RTCA DO-347 and RTCA DO-311. This AC provides guidance on how to obtain installation approval for installed rechargeable lithium battery and battery systems on aircraft.	DO-311A is being submitted to the PMC for approval. DO-311A includes changes that SC-225 learned while developed DO-347 and it also include changes relating to NTSB recommendation. Should consider removing reference to D0-347 and DO-311 then only reference DO-311A. The PMC meeting of June 18, 2015 is expected to release DO-311A and sunset DO-347.	We proposed editing the proposed text as follows: 1.1.1 This AC provides an acceptable means to show compliance to the airworthiness requirements for installed rechargeable lithium battery and battery systems on aircraft as described in RTCA, Inc., document~~s RTCA DO-347~~ and RTCA DO-311***A*** . This AC provides guidance on how to obtain installation approval for installed rechargeable lithium battery and battery systems on aircraft.	Conceptual	Agree with modification:- This AC can only address existing published and released documents. Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's

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44	FAA proposed AC 20-184x	1-2	section 1.3.2	The proposed text states: 1.3.2 Lithium batteries have certain failure and operational characteristics, as well as maintenance requirements, which differ significantly from those of nickel cadmium and lead-acid rechargeable batteries. The introduction of lithium batteries into aircraft raises some concern about associated battery monitoring systems (such as temperature or state of charge) and should be evaluated and tested regarding the expected extremes in the aircraft operating environment. Lithium batteries typically have different electrical impedance characteristics than lead-acid or nickel cadmium batteries. Other components of the aircraft electrical system should be evaluated regarding these characteristics as a system.	We proposed to delete these sentences. We do not understand the FAA's intention with these sentences. First – We don't agree to reference only the battery monitoring systems. Why only the battery monitoring systems? Also evaluate and test at extremes aircraft environment is expected for all equipment installed on the aircraft. Second – We don't agree to reference only electrical impedance. Why just electrical impedance? Sentence is too narrow. Third – The last sentence is too broad and vague. Either should be deleted or explain further.	We proposed editing the proposed text as follows: 1.3.2 Lithium batteries have certain failure and operational characteristics, as well as maintenance requirements, which differ significantly from those of nickel cadmium and lead-acid rechargeable batteries. ~~The introduction of lithium batteries into aircraft raises some concern about associated battery monitoring systems (such as temperature or state of charge) and should be evaluated and tested regarding the expected extremes in the aircraft operating environment. Lithium batteries typically have different electrical impedance characteristics than lead-acid or nickel cadmium batteries. Other components of the aircraft electrical system should be evaluated regarding these characteristics as a system.~~	Conceptual	Agree with modification- Document updated.

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45	FAA proposed AC 20-184x	1-2	section 1.4.2	The proposed text states: 1.4.2 At present, there is limited in-service experience with the use of lithium battery technology in applications on aircraft. However, users of this technology from aircraft operators to personal computer users, wireless telephone manufacturers, and the electric vehicle industry have noted safety problems with lithium batteries. These known potential safety problems may result from overcharging, over-discharging, internal cell defects and flammability of cell components. In general, lithium batteries are significantly more susceptible to internal failures that can result in self-sustaining increases in temperature and pressure (that is, thermal runaway) than nickel-cadmium or lead-acid batteries. The following	It clarifies the intent	We proposed to add the word "***cell***" to the text as follows: 1.4.2 At present, there is limited in-service experience with the use of lithium battery technology in applications on aircraft. However, users of this technology from aircraft operators to personal computer users, wireless telephone manufacturers, and the electric vehicle industry have noted safety problems with lithium batteries. These known potential safety problems may result from overcharging, over-discharging, internal cell defects and flammability of cell components. In general, lithium batteries are significantly more susceptible to internal ***cell*** failures that can result in self-sustaining increases in temperature and pressure (that is, thermal runaway) than nickel-cadmium or lead-acid batteries. The following are examples of the possible failures of lithium batteries:	Editorial	Agree - Document updated.
46	FAA proposed AC 20-184x	1-3	section 1.4.2.2	The proposed text states: Discharge of some types of lithium batteries beyond a certain voltage (typically 2.4 volts) can cause corrosion of the cell electrodes, resulting in loss of battery capacity that cannot be reversed by recharging.	Original wording implies battery is at 2.4 volts. This is incorrect. The parenthetical statement refers to the cell.	We proposed adding the words "***at the cell level***" to the text as follows: Discharge of some types of lithium batteries beyond a certain voltage (typically 2.4 volts ***at the cell level***) can cause corrosion of the cell electrodes, resulting in loss of battery capacity that cannot be reversed by recharging.	Editorial	Agree with modification Document updated.

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47	FAA proposed AC 20-184x	1-3	section 1.4.2.3	The proposed text states: Unlike nickel-cadmium and lead-acid batteries, some types of lithium batteries use liquid electrolytes that are flammable. The electrolyte can serve as a source of fire. This material can serve as a source of fuel for an external fire if a cell failure occurs. Lithium batteries have the potential to ignite spontaneously or experience an uncontrolled temperature and pressure increase, resulting in propagation to adjacent cells	It is the cell that “ignites spontaneously” and that experiences thermal runaway (uncontrolled increases in temperature and pressure).	We proposed adding the words "***for cells***" to the text as follow: Unlike nickel-cadmium and lead-acid batteries, some types of lithium batteries use liquid electrolytes that are flammable. The electrolyte can serve as a source of fire. This material can serve as a source of fuel for an external fire if a cell failure occurs. Lithium batteries have the potential ***for cells*** to ignite spontaneously or experience an uncontrolled temperature and pressure increase, resulting in propagation to adjacent cells	Editorial	Agree with modifications- Document updated.
48	FAA proposed AC 20-184x	2-4	2.3.1.1.2	The proposed text states: 2.3.1.1.2 RTCA DO-347, Certification Test Guidance for Small and Medium Rechargeable Lithium Batteries and Battery Systems, dated December 18, 2013; and	We proposed to delete this requirement. It will be invalid before the AC is released. The PMC meeting of June 18, 2015 is expected to release DO-311A and sunset DO-347.	~~2.3.1.1.2 RTCA DO-347, Certification Test Guidance for Small and Medium Rechargeable Lithium Batteries and Battery Systems, dated December 18, 2013; and~~	Conceptual	Agree with modification - This AC can only address existing published and released documents. Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's
49	FAA proposed AC 20-184x	2-4	2.3.1.1.3	The proposed text states: 2.3.1.1.3 RTCA DO-311, Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems, dated March 13, 2008.	The PMC meeting of June 18, 2015 is expected to release DO-311A and sunset DO-347.	We recommend editing the text as follows: 2.3.1.1.3 RTCA DO-311***A*** , Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems, dated ***June XX, 2015*** ~~March 13, 2008~~.	Editorial	Agree with modification - This AC can only address existing published and released documents. Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's

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50	FAA proposed AC 20-184x	2-4	2.3.1.2	The proposed text states: 2.3.1.2 These environmental tests are representative of the conditions that the battery system may encounter during its life cycle. Consider the following areas when determining the scope and type of environmental tests: 2.3.1.2.1 Equipment configuration, 2.3.1.2.2 Installation-specific environment encountered on in-service platforms, 2.3.1.2.3 Duration of exposure periods, 2.3.1.2.4 Geographical locations, and 2.3.1.2.5 Frequency of environmental occurrences alone or in combination.	We propose to delete this section entirely. We want to avoid duplication with other documents. This is just a restatement of 2.3.1.1.1 (DO-160). Also, it is unknown what is meant by requirements 2.3.1.2.4 Geographic locations and 2.3.1.2.5 Frequency of environmental occurrences alone or in combination.	We proposed deleting this entire section. ~~2.3.1.2 These environmental tests are representative of the conditions that the battery system may encounter during its life cycle. Consider the following areas when determining the scope and type of environmental tests:~~ ~~2.3.1.2.1 Equipment configuration,~~ ~~2.3.1.2.2 Installation-specific environment encountered on in-service platforms,~~ ~~2.3.1.2.3 Duration of exposure periods,~~ ~~2.3.1.2.4 Geographical locations, and~~ ~~2.3.1.2.5 Frequency of environmental occurrences alone or in combination.~~	Conceptual	Disagree - The reiteration of this guidance material are required for clarity and completeness.
51	FAA proposed AC 20-184x	2-4	2.3.2	The proposed text states: Follow the guidance in appendix E to this AC for very small, small, and medium lithium batteries, and the guidance in appendix F for large lithium batteries, to show compliance to the requirements of the airworthiness regulations and any special conditions imposed by the directorates.	The PMC meeting of June 18, 2015 is expected to release DO-311A and sunset DO-347. Once we switch do DO-311A then all this structure need to be changed.	We propose editing the text as follows: Follow the guidance in appendix ***TBD*** ~~E~~ to this AC ~~for very small, small, and medium lithium batteries, and the guidance in appendix F for large lithium batteries,~~ to show compliance to the requirements of the airworthiness regulations and any special conditions imposed by the directorates.	Conceptual	Agree with modification - This AC can only address existing published and released documents. Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's

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52	FAA proposed AC 20-184x	2-5	2.4.1.8	The proposed text states: 2.4.1.8 Statement of compliance for each requirement and each mitigating design feature.	What requirement is the text referring to? It can be very burdensome.	Rewrite for clarity.	Conceptual	Agree - This section is under the System Safety Assessment section. Therfore the sub-section applies to the SSA and compliance to XX.1309.Document updated.
53	FAA proposed AC 20-184x	2-5	2.4.2	The proposed text states: 2.4.2 Coordinate your assessment with the responsible FAA Aircraft Certification Office to determine the depth of analysis required. Include a system description, a description of how the system is installed on the aircraft, and a list of functions and criticality. You can find additional guidance in appendix B to this AC.	Does this mean a preliminary safety analysis is required to be coordinated with the FAA?.	The text is not clear. Rewrite for clarity.	Conceptual	Disagree- This is a normal certification process.
54	FAA proposed AC 20-184x	2-6	section 2.6	The proposed text states: Any lithium batteries hardware that contains complex electronic hardware should comply with the most recent revision of RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware, and AC 20-152, RTCA, Inc., Document RTCA/DO 254, Design Assurance Guidance for Airborne Electronic Hardware, dated June 30, 2005.	Reference is repeated	We proposed editing the text as follows: Any lithium batteries hardware that contains complex electronic hardware should comply with the most recent revision of RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware, and AC 20-152. ~~RTCA, Inc., Document RTCA/DO 254, Design Assurance Guidance for Airborne Electronic Hardware, dated June 30, 2005.~~	Editorial	Agree - Document updated.

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55	FAA proposed AC 20-184x	2-6	section 2.7	The proposed text states: Lithium batteries that are not maintained at a high enough state of charge degrade at a significantly higher rate. Additionally, overcharging of individual cells could lead to thermal runaway. Health monitoring of lithium batteries needs to be taken into account during testing and certification to ensure that proper state of charge can be maintained.	We propose to delete this sentence. It does not seem to be in the right section. What does overcharging have anything to do with this State of Charge section? As written it is not clear the FAA's purpose to have a State of Charge section when there is not a lot of descriptive information written about it.	We propose editing the text as follows: Lithium batteries that are not maintained at a high enough state of charge degrade at a significantly higher rate. ~~Additionally, overcharging of individual cells could lead to thermal runaway.~~ Health monitoring of lithium batteries needs to be taken into account during testing and certification to ensure that proper state of charge can be maintained.	Conceptual	Partially agree - The title was changed to Health Monitoring.
56	FAA proposed AC 20-184x	2-8	2.9.8	The proposed text states: 2.9.8 The ICA must contain instructions to replace batteries based on the lithium batteries original equipment manufacturer (OEM) maintenance manual. Replacement of individual cells within lithium batteries must be approved by the lithium battery's OEM and the FAA	Not sure if this statement is correctly written. If the instruction is in the ICA then it should already be approved by the FAA.	We propose editing the text as follows: 2.9.8 The ICA must contain instructions to replace batteries based on the lithium batteries original equipment manufacturer (OEM) maintenance manual. Replacement of individual cells within lithium batteries must be approved by the lithium battery's OEM ~~and the FAA~~.	Editorial	Disagree - FAA must concur with the replacement
57	FAA proposed AC 20-184x	3-1	Chapter 3	Entire chapter is about Maintenance, storage and handling of lithium batteries.	Most, if not all, of this material is already covered by section 2.9 Instructions for Continued Airworthiness (ICA).	Delete all material in this section that is already covered by section 2.9 Instructions for Continued Airworthiness (ICA). Move any remaining material that should be the ICA to section 2.9.	Conceptual	Agree - Document updated.

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58	FAA proposed AC 20-184x	3-1	section 3.2.2	The proposed text states: To determine the life and age of the lithium battery, record the install date of the battery. During normal battery maintenance, document battery age in either the aircraft maintenance log or the shop maintenance log. Do not keep batteries in service longer than recommended by the lithium batteries manufacturer.	Age should not be considered unless it can affect safety.	We recommend to delete this section.	Conceptual	Disagree -The age of the battery does affect battery state of health and therefore affects safety.
59	FAA proposed AC 20-184x	3-1	section 3.2.3	The proposed text states: State of charge of the lithium battery will be determined by the cumulative effect of charging and discharging the battery. In a normal electrical charging system, the generator or alternator restores a battery to full charge during a flight of 1 hour to 90 minutes regardless of use before flight. However, safeguards must be implemented to ensure the aircraft does not begin flight with a battery not sufficiently charged to accomplish the intended function of the lithium battery.	If state of charge is required there has to be an indication for state of charge.	We recommend to rewrite this section for better clarify.	Conceptual	Agree but not incorporated-The last sentence of paragraph 3.2.3 implies measurement of state of charge. It is written generically to allow flexibility in implementation

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60	FAA proposed AC 20-184x	3-2	section 3.2.5	The proposed text states: …The venting system should take into account specific installation requirements of the aircraft.	The aircraft venting system needs to be designed to handle any battery emissions as specified by the battery manufacturer.	We recommend to edit the last sentence as follows: …The venting system should take into account specific installation requirements of the aircraft ***as well as specific installation requirements from the battery manufacturer.***	Conceptual	Agree with modification- Documement revised.
61	FAA proposed AC 20-184x	3-2	section 3.2.9	The proposed text states: Batteries in a rotable stock must be functionally checked at the manufacturer's recommended inspection intervals. Some failure modes may include degraded charge retention capability, settling of particulates, or other damage due to prolonged storage.	Not only do batteries require regular inspection, they also require regular servicing.	We recommend adding a new sentence to the proposed text as follows: Batteries in a rotable stock must be functionally checked at the manufacturer's recommended inspection intervals. Some failure modes may include degraded charge retention capability, settling of particulates, or other damage due to prolonged storage. ***Batteries in rotable stock may also require periodic servicing per the manufacturer's instructions.***	Conceptual	Agree - Documement revised.
62	FAA proposed AC 20-184x	3-3	section 3.4	This section deals with Aircraft Battery Storage and Handling	This section is already covered by section 2.9 Instructions for Continued Airworthiness (ICA). The operator is not going to be using this AC but the will follow the ICA provided.	We recommend to move entire section to section 2.9	Conceptual	Disagree - It is appropriate to include ground handling procedures in this as a separate section.

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63	FAA proposed AC 20-184x	A-1	Table A-1	This table defines the MOC for different sizes of batteries, based on definitions from DO-347.	The PMC meeting of June 18, 2015 is expected to release DO-311A and sunset DO-347.	DO-347 is going away. 1. Remove all references to DO-347. 2. Combine the rows for small, medium and large into a single row. There will result in two rows for the table “Very Small” and “Everything Else”. 3. Update all references from DO-311 to DO-311A 4. Remove references to Appendix E and F and replace with Appendix TBD. These two appendices will need to be merged into a single matrix once DO-311A is released.	Conceptual	Agreed with modification - This AC can only address existing published and released documents. Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's
64	FAA proposed AC 20-184x	C-1	C.1.2	The proposed text states: Battery Cell. In a battery, a cell is a single energy or charge-storing unit within a pack of cells that form the battery. Each cell has a voltage rating that is combined with the other cells’ voltages to form the overall battery voltage rating.	It clarifies the sentence.	We recommend adding the words "***one or more***" to the proposed text as follows: Battery Cell. In a battery, a cell is a single energy or charge-storing unit within a pack of ***one or more*** cells that form the battery. Each cell has a voltage rating that is combined with the other cells’ voltages to form the overall battery voltage rating.	Editorial	Agree-Documement revised.
65	FAA proposed AC 20-184x	C-2	C.1.11	The proposed text states: Service Life. The maximum combined storage and installed life of an undischarged cell or battery. Service life cannot be greater than shelf life and will be stated by the equipment manufacturer. The end of service life is indicated by a “replace-by” or expiration date. Service life is equivalent to useful life.	It seems that this term is defined wrong.	We recommend editing the text as follows: Service Life. The maximum combined storage and installed life of an undischarged cell or battery. Service life cannot be ***less*** ~~greater~~ than shelf life and will be stated by the equipment manufacturer. The end of service life is indicated by a “replace-by” or expiration date. Service life is equivalent to useful life.	Editorial	Agree - Documement revised.

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66	FAA proposed AC 20-184x	D-1	Special Condition 1	The proposed text states: Special Condition Requirement #1: Safe cell temperatures and pressures must be maintained during any foreseeable charging or discharging condition and during any failure of the charging or battery monitoring system not shown to be extremely remote. The rechargeable lithium battery installation must preclude explosion in the event of those failures.	The Special Condition 1 cannot be met as written.	The statement “must preclude explosion in the event of those failures” cannot be met. A failure of the charging or battery monitoring system can cause unsafe cell temperatures and pressures, which can cause a cell to vent combustible liquids and gases which have the potential to ignite and cause an explosion. Unsafe cell temperatures and pressure can also cause a thermal runaway event. When cells go into thermal runaway, they can explode or emit combustible liquids and gases which have the potential to ignite and cause an explosion. Thus, the failure of the charging system has the potential to cause an explosion. In addition, unsafe cell temperatures and pressures can occur for reasons other than charging or discharging. The Special Condition 1 needs to be re-written to allow containment or mitigation of the effects of an explosion.	Conceptual	Disagree- Special conditions listed in the AC are a typical SC that was published in the NPRM. They cannot be altered in the AC. AC allows flexibility for the ACO and directorate to develop SC tailored to specific project requirements .

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67	FAA proposed AC 20-184x	D-1	Special Condition 1, Intent section	The proposed text states: Special Condition Requirement #1: Safe cell temperatures and pressures must be maintained during any foreseeable charging or discharging condition and during any failure of the charging or battery monitoring system not shown to be extremely remote. The rechargeable lithium battery installation must preclude explosion in the event of those failures. The intent of this SC requirement: The cells within the lithium battery system shall be designed to minimize the impact of self sustained, uncontrolled increases in cell temperature or pressure, as a result of any foreseeable charging or discharging condition. The probability of this event must be shown to	The Intent Section does not match the Special Condition. We recommend to align the intent section with the requirements of the special condition.	The subject of Special Condition 1 is “safe cell temperatures and pressures”. However, the Intent section switches the subject to thermal runaway (“self-sustained, uncontrolled increases in cell temperature or pressure”). A cell could have unsafe cell temperatures (too low or too high) without going into thermal runaway. Discussing thermal runaway limits the scope of the Intent section. Also, explosions cannot be precluded (see comment 10). The intent section needs to be re-written to match the Special Condition.	Conceptual	Disagree - The intent matches the SC.

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68	FAA proposed AC 20-184x	D-1	Special Condition 2	The proposed text states: Special Condition Requirement #2: Design of the rechargeable lithium batteries must preclude the occurrence of self-sustaining, uncontrolled increases in temperature or pressure.	This Special Condition 2 is not possible to meet in its present form.	The terms used “self-sustaining, uncontrolled increases in temperature or pressure” (a.k.a. thermal runaway) cannot be precluded. Internal shorting of cells leads to “self-sustaining, uncontrolled increases in temperature or pressure”. The failure rate for internal shorting of cells is on the order of 10-5 for custom built cells to 10-7 for commercial cells. Thus thermal runaway cannot be precluded. This special condition must be re-written to allow containment of thermal runaway events (self-sustaining, uncontrolled increases in temperature or pressure). Also, Special Condition 2 implies that it is batteries that undergo thermal runaway. This is not the case. It is the cell(s) that goes into thermal runaway. Note: A thermal runaway event could propagate from cell to cell,	Conceptual	Disagree - Special conditions listed in the AC are a typical SC that was published in the NPRM. They cannot be altered in the AC. AC allows flexibility for the ACO and directorate to develop SC and MOC tailored to specific project requirements .

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69	FAA proposed AC 20-184x	D-3	Special Condition Requirement #6	The proposed text states: Special Condition Requirement #6: Each rechargeable lithium battery installation must have provisions to prevent any hazardous effect on structure or essential systems caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells. The intent of this SC requirement: The lithium battery system shall be designed to minimize the impact of self-sustained, uncontrolled increases in temperature or pressure, as a result of cell failures (for example, internal cell short circuit) or a short circuit of the battery. It shall prevent any hazardous effect on adjacent or nearby structures or essential	The Intent Section does not match the Special Condition. We recommend to align the intent section with the requirements of the special condition.	First - The Special Condition deals only with short circuits of the battery or cells. However, the intent section introduces the term “cell failures”. There are many types of cell failures, but the Special Condition does not address them. The intent section needs to be re-written to match the Special Condition. Second - The intent section introduces thermal runaway (self-sustained, uncontrolled increases in temperature or pressure). This is not addressed in the Special Condition. The amount of heat that can be generated due to a short is much different that the amount of heat generated as a result of a thermal runaway. The intent section need to be re-written to match the Special Condition.	Conceptual	Disagree - The intent matches the SC. As published in the NPRM.

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70	FAA proposed AC 20-184x	D-3	Special Condition Requirement #7, Intent Section.	The proposed text states: Special Condition Requirement #7: The lithium battery system must have a capability to control the charging rate of the battery automatically, so as to prevent battery overheating or overcharging, and… The intent of this SC requirement: The rechargeable lithium battery or battery system shall have protective features to prevent unsafe conditions during operation…	Reword the Intent Section to match the wording of the Special Condition.	We recommend editing the proposed text as follows: Special Condition Requirement #7: The lithium battery system must have a capability to control the charging rate of the battery automatically, so as to prevent battery overheating or overcharging, and… The intent of this SC requirement: The rechargeable lithium battery or battery system shall have protective features to prevent ***battery overheating or overcharging*** ~~*unsafe* conditions during operation…~~	Editorial	Disagree - The intent matches the SC published in the NPRM.
71	FAA proposed AC 20-184x	E-1 and F-1	Appendix E and F	Appendix E and Appendix F – Means of compliance	The PMC meeting of June 18, 2015 is expected to release DO-311A and sunset DO-347.	We recommend the following: 1. Merge these two appendices into a single appendix. 2. Remove references to DO-347. 3. Update all references from DO-311 to DO-311A 4. Remove all references to size – DO-311A does not identify any limitations based on size (other than for very small batteries/cells).	Conceptual	Agree with modification - This AC can only address existing published and released documents. Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's
72	FAA proposed AC 20-184x	G-1	Appendix G	Flow chart for MOC	The PMC meeting of June 18, 2015 is expected to release DO-311A and sunset DO-347.	Need to re-evaluate the flow chart. Step 1 is already confusing. All need to be change because of DO-311A	Conceptual	Agree with modification - This AC can only address existing published and released documents. Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's

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73	AC20-184	3-Jan	1.4.2.1	Overcharging	Comment	Add that lithium dendrites are formed during an overcharging process. This is the major hazard cause for a catastrophic failure under an overcharge condition.	Conceptual	Disgree - The purpose here is to describe conditions that could lead to potential failures and not to discuss the specific failure mechanism.
74	AC20-184	3-Jan	1.4.2	N/A	Comment	Add extreme temperatures and external short hazards; these are major hazard causes that lead to catastrophic failures and they have not been listec.	Conceptual	Partially agreed- Document updated and added to address extreme temperature.The list is not meant to be an all inclusive list.
75	AC20-184	6-Feb	2.7	State of charge	Comment	The first sentence says that if the batteries are not stored at a high enough state of charge, they degrade at a significantly high rate. This statement is not fully true because the voltage drop or self discharge depends on many different factors - the state of charge, the complexity of the electronics, the storage temperature, etc. So, I would recommend that this be reworded: Lithium batteries should be stored in accordance with the manufacturer's recommendations for state of charge and temperature; consideration should be provided for any monitoring circuitry that may drain the battery during the storage period.	Conceptual	Agree - Suggestion adopted and document updated.
76	AC20-184	1-Mar	3.2.2	Age	Comment	The date of battery manufacturing should also be recorded. The date of installation may not reflect the actual age of the battery. Even with the date of battery manufacturing, an assumption is being made that the cells were manufactured not too far ahead of the battery manufacturing date.	Conceptual	Agree - Updated document to include manufacturer's and or installation date.

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77	AC20-184	2-Mar	3.2.8	Aircraft battery inspection	Comment	Add that cell to cell connections should be periodically inspected as take off and landing loads can cause them to loosen.	Conceptual	Disagree - In order to conduct periodic inspections cell to cell, the enclosure must be opened. This would require the battery to be requalified.
78	AC20-184	2-Mar	3.2.8	Aircraft battery inspection	Comment	Add checks that verify that the battery connector is tight enough for the same rationale given above	Conceptual	Agreed- This inspection is included in section 3.2.8.2 during manufacturer's recommended inspection intervals.
79	AC20-184	2-Mar	3.3.1	Aircraft battery replacement	Comment	In the first sentence add what is performed to confirm airworthy condition. Are they capacity checks or open circuit voltage checks?	Conceptual	Agree with comment- This will depend on the design of the battery and the manufacturer's specification.
80	AC20-184	3-Mar	3.4.1	Aircraft battery storage and handling	Comment	Add that storage procedures will need to include information on storage temperature and state of charge as these are critical to maintain a good healthy battery for longer periods.	Conceptual	Agree with comment- The temperature and state of charge and other applicable parameters must be included in the manufacturer's storage procedure.
81	AC20-184	D-1	Appendix D SCR#1	Special condition requirement #1	Comment	Add the words "fire and/or" before te word "explosion" in the last sentences of the first paragraph and last paragraph. Since fire is a hazard that needs to be avoided.	Conceptual	Disagree - The SC #1 is part of the published special conditions in the the NPRM. They are stated as typical special conditions and will be addressed by the applicable directorates and aircraft certification offices.
82	AC20-184	D-3	Appendix D SCR#6	Special condition requirement #6	Comment	Add "smoke or fire" after "heat" in the first paragraph as these should also be considered to be hazardous and not allowed.	Conceptual	Disagree - The SC #6 is part of the published special conditions in the the NPRM. They are stated as typical special conditions and will be addressed by the applicable directorates and aircraft certification offices.

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83	AC20-184	D-4	Appendiz D SCR#9	Special condition requirement #9	Comment	Add information that any maintenance of the battery during storage periods that may include charge and discharge cycles that should be carried out within the manufacturer's specifications for temperature range and rating for loads based on the environmental temperatures.	Conceptual	Disagree - The SC #9 is part of the published special conditions in the the NPRM. They are stated as typical special conditions and will be addressed by the applicable directorates and aircraft certification offices.
84	AC20-184	E-1	2.3.8 and 2.3.9		Comment	Add that this is short circuit test of a battery	Conceptual	Disagree - This is the test from RTCA DO-347. Cannot be changed by the AC.
85	AC20-184	E-1	2.3.13 and 2.3.14		Comment	Add that these are for the battery	Conceptual	Disagree - This is the test from RTCA DO-347. Cannot be changed by the AC.
86	AC20-184	F-1	RTCA DO-311	RTCA-DO-311 sections	Comment	1.5.6 should read "prevention of thermal runaway propagation"	Conceptual	Disagree - This is the test from RTCA DO-311. Cannot be changed by the AC.
87	ARbus AC 20-184	Appendix A	A-1	For the small and Medium batteries: A Functional Hazard Assessment, System Safety Assessment, Fault Tree Analysis and /or Failure Modes and Effects Analysis, as applicable, must be accomplished per 14 CFR 23/25/27/29.1309 and 25.1709.	Similar requirement in DO-347 *Safety Analysis, such as a FHA, or a Failure Modes and Effects Analysis (FMEA), may need to be conducted as required by the appropriate regulatory in order to meet the equipment installation DAL.*	AC should refer to DO-347		Disagree - Text as is is based on FAR requirement.

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88	AC 20-184	Appendix D	D-1 SC#1	The intent of this SC requirement: The cells within the lithium battery system shall be designed to minimize the impact of self sustained, uncontrolled increases in cell temperature or pressure, as a result of any foreseeable charging or discharging condition. The probability of this event must be shown to be extremely remote (1 event in 10 million (1x10-7) flight hours). It must preclude explosion in the event of any failure.	For clarification, the sentence " It must preclude explosion in the event of any failure" should refer to not extremely remote case	Modify as follow:The cells within the lithium battery system shall be designed to minimize the impact of self sustained, uncontrolled increases in cell temperature or pressure, as a result of any foreseeable charging or discharging condition. The probability of this event must be shown to be extremely remote (1 event in 10 million (1x10-7) flight hours). *The rechargeable lithium battery installation* must preclude explosion *in the event of those not be shown to be extremely remote failure.*		Disagree - Special conditions listed in the AC are a typical SC that was published in the NPRM. They cannot be altered in the AC.
89	AC 20-184	2-8	2.9.7	The ICA should also contain maintenance procedures for lithium batteries in spares storage to prevent the replacement of batteries with batteries that have experienced degraded charge retention ability or other damage due to prolonged storage.	The aircraft level TCH declares ICAs in compliance with 25.1529 & Apx H. These include aircraft level Airworthiness Limitations and MRB tasks developed through analysis required to comply with Part 25 requirements. ICAs include the AMM but not CMMs, unless the instruction is required on-aircraft or the CMM contains a fuel tank safety CDCCL. Consequently it is questioned how maintenance procedures on batteries in spares storage can be identified as ICAs. This information will be included in CMMs. How will these CMMs be identified as containing ICAs? Operators are required to comply with ICAs provided by the airframe and engine TC Holders.	Replace: *The ICA should also contain* **by** *The supplier's CMM should also contain….*		Disagree - The ICA may include the supplier's CMM. The person finding compliance to XX.1529 can choose the aapropriate documents in order to find compliance to the regulations.

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90	AC 20-184	3-1	3.2.2	To determine the life and age of the lithium battery, record the install date of the battery. During normal battery maintenance, document battery age in either the aircraft maintenance log or the shop maintenance log. Do not keep batteries in service longer than recommended by the lithium batteries manufacturer.	Battery life may be determined with reference to manufacturing date. Calculating service life based on installation date may not be appropriate.	Modify the AC to refer to DO-347		Diagreed- RTCA DO-347 is not prescriptive. We did update the document to include manufacturing or installation date.
91	AC 20-184	3-2	3.2.8	Evidence of battery failure can sometimes be detected by a general visual inspection. Manufacturer recommended inspections should include, but not be limited to, the following actions:	The examples 3.2.8.1, 2, 3 & 4 would require a detailed inspection to be effective. A GVI can be performed within touching distance which may be insufficient to identify the type of degradation expected to be noted during this task	Change *'general visual inspection'* to *'visual inspection'*. This will allow either a general or detailed inspection to be selected.		Agree - Modified document.
92	AC 20-184	3-2	3.3.2	The ICA should include the manufacturer's recommendations for the battery mandatory replacement schedule and periodic maintenance.	Mandatory requirements are identified in Airworthiness Limitation Sections (ALS) as required by Apx H25.4 or by issuance of Airworthiness Directives (ADs). Intervals identified in other ICAs are not mandatory.	Delete the word ***'mandatory'*** from the sentence		Disagree - The manufacturer's recommendation need to be addressed in the ICA.
93	AC20-184 Draft	1-2	1.3.1	"Some of the benefits of lithium batteries include…good low temperature performance…."	Comment: This statement may not be accurate. I do not believe that lithium batteries are generally recognized for having good low temperature performance compared to Ni-Cd batteries. There are challenges related to charging cold lithium cells.	Delete statement about "good low temperature performance."	Conceptual	Disagree - In general lithium batteries have good low temperature performance that is equivalent or greater than NiCads.

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94	AC20-184 Draft	1.2	1.4.2	1.4.2: “In general, lithium batteries are significantly more susceptible to internal failures that can result in self-sustaining increases in temperature and pressure (that is, thermal runaway) than nickel-cadmium or lead acid batteries….”	Comment: Recommend that it states “than EXISTING nickel-cadmium or…” because early Ni-Cd batteries also had volatile susceptibilities.	Add “existing” in front of “nickel-cadmium”	Conceptual	Agree - Document updated.
95	AC20-184 Draft	1-3	1.4.2.2	“Discharge of some types of lithium batteries beyond a certain voltage (typically 2.4 volts) can cause corrosion of the cell electrodes….”	Comment: Lithium cells, depending on chemistry, have nominal voltages between 3.3V to 4.2V, and max recommended voltages of 3.6V to 5.0V. Similarly, the low voltage threshold could be below 2.5V. There is enough variation between chemistries that “2.4 volts” may not be “typical”.	Either delete “(typically 2.4 volts)” or restate as “(for example: 2.4 volts)”	Conceptual	Agree with modification- Document updated.
96	AC20-184 Draft	1-3	1.4.2.3	“This material can serve as a source of fuel for an external fire if a cell failure occurs….”	Comment: The term “external” can be confused as “external to the battery case” only, when the text usage here suggests the meaning of “external to the cell case”. Recommend deleting “an external” so that the sentence changes to “This material can serve as a source of fuel for a fire if a cell failure occurs….”	Delete “an external”	Conceptual	Disagree- Statement was Intended to address external fire.It was intended to address fires external to cell case as well external to the battery case.
97	AC20-184 Draft	2-4	2.3.1	Title is “Environmental Test Requirements” even though it lists RTCA DO-347 and RTCA DO-311.	Comment: This title may not be accurate. The section title does not properly describe all the requirements being referenced.	Rename title to “Test Requirements”	Editorial	Disagree - This section 2.3.1 specifically refer to the environmental test requirements. The main title 2.3 is indeed Test Requirements and we do have 2.3.2 and 2.3.3 that deals with other tests as well..

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98	AC20-184 Draft	2-6	2.7	"Lithium batteries that are not maintained at a high enough state of charge degrade at a significantly higher rate…."	Comment: This statement may not be accurate. I am not aware that DECREASING SOC results in INCREASED capacity loss rate. Popular recommendations include storing Lithium batteries at 50%SOC with the general understanding that storage at 100%SOC and 0%SOC can lead to higher capacity loss rate than at 50%SOC.	Delete this statement because it may not be accurate.	Conceptual	Agree but not modified- The title was changed to Health Monitoring and reworded the paragraph.Another previous comment addressed this as well.
99	AC20-184 Draft	2-6	2.8	Flammability - "Test the materials to ensure they meet applicable requirements of §§ 23/25/27/29.853, and 25.869."	Comment: This AC adds reference to the FAA Aircraft Materials Fire Test Handbook and to the AC 25.856-1 Thermal/Acoustic Insulation Flame Propagation Test Method Details. The flammability section of AC20-184 can be confusing enough that a less stringent or inapplicable test is used to demonstrate compliance (e.g. horizontal burn is less stringent than a vertical burn test) and it has text that appear to be contradictory when AC20-184 and AC25.869-1 are read together. It is recommended that the FAA write an advisory circular or means of compliance directly related to the flammability testing of battery materials instead of referencing test methods that were written for aircraft interior materials. • The Aircraft Materials Fire Test Handbook and AC25.856-1 were written mostly for the flammability testing/burning of interior cabin materials. These references define various test methods (Various burn tests with either the material specimen or the Bunsen burner placed in various orientations) and material specimen sizes and preparation methods; The applicability of each of these burn tests	• Delete references to the Aircraft Materials Fire Test Handbook, AC25.856-1, and replace with very specific guidance defining burn test methods for materials used in specific places inside a battery assembly. • Write a separate AC or provide more specific Means of Compliance instruction in this AC for battery material flammability testing. For example: • "All non-metallic/non-elastomeric materials of the battery that do not meet the small parts exemption shall be tested to a 12 second vertical burn test. Example materials include: FR-4 printed circuit boards, thermal/electrical insulation." • "All elastomeric materials of the battery that do not meet the small parts exemption or that are used as seals/gaskets shall be tested to a 2.5 inch, 15 second horizontal burn test. Example materials include: battery case/lid seals/gaskets, connector seals/gaskets, thermal/electrical insulation, heater blankets." Then the battery materials	Conceptual	Disagree- Materials used must still meet the flammability requirements. They have to meet all applicable airworthiness regulations.

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100	AC20-184 Draft	2-6	2.8	Flammability - “Test the materials to ensure they meet applicable requirements of §§ 23/25/27/29.853, and 25.869.”	The flammability section only evaluates material robustness against a fire. A candle fire has a temperature of +1600degF (871degC). However, when one or more cells vent in the battery and a fire does not occur, it can produce gases in the 200degC-400degC (392degF to 752degF) range. • The 200-400degC temperature range can result in the thermal decomposition of materials intended to act as thermal/electrical insulation. This loss of thermal/electrical insulation can lead to propagation. • Although most carbonate solvents in the Li-Ion battery electrolyte have an auto-ignition temperature range of 445degC (833degF) to 485degC (905degF), materials including rubber may have an even lower auto-ignition temperature. A material with an even lower auto-ignition temperature can ignite and quickly raise the temperature to a point of ignition the electrolyte.	• Recommend providing guidance for material thermal decomposition evaluation. Two test methods that could be used are Thermo-Gravimetric Analysis (ASTM E1131) and Differential Scanning Calorimetry (ASTM F2625). An alternate approach is to require a post-test teardown of the batteries after the DO-311/DO-347 destructive test to identify any materials that had degraded and were no longer performing their intended thermal/electrical insulation function. Recommend providing guidance for material auto-ignition evaluation. Two test methods that could be used are ASTM E659 or D1929. An alternate approach is to place the material samples into a kiln and raise the temperature to 445degC. Place a thermocouple underneath the material sample and one more about 1 inch above the material surface. If none of the materials auto-ignite, both thermocouples will read the same temperature throughout the test. If there is no	Conceptual	Disagree - The test conditions specified in each test would determine the amount of evaluations required.These evaluations may depend on the design and chemistry of the lthium batteries..

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101	AC20-184 Draft	2-7	2.9.6	"The ICA must contain…."	Comment: Should the ICA be required to have instructions for the clean-up of vented/spilled electrolyte liquid/gas to enable an aircraft to return to service?	• Recommend requiring electrolyte clean-up instructions in battery manuals to enable an aircraft to be cleared for return to service. One method is to require a test of exposing the vented electrolyte gas/liquid to common aircraft parts/surfaces (such as flight control wire rope, epoxy/paint coated surfaces, common composite structure, aluminum/steel) to verify that no significant corrosion has occurred due to a limited time exposure. An alternative, since the electrolyte composition is commonly the same, is for the FAA Technical Center to perform these tests and verify that these standard aircraft materials can remain airworthy after short time exposure to the electrolyte.	Conceptual	Agreed but not adopted The list prvided is a minimum that is needed. There may be other mainteenance requirement beyond what is suggested. This AC does not provide all the neccesary inspection criteria and is expected to be captured in the ICA in compliance to XX.1529. the applicant has to provide these recommendations based on the requirements of their equipment..
102	AC20-184 Draft	2-8	2.9.6.3	"Maintenance requirements for measurements of battery capacity at appropriate intervals to ensure the batteries whose function is required for safe operation of the aircraft will perform their intended function as long as they are installed in the aircraft."	Comment: Sentence is too long to follow, perhaps need to add some commas?	Add two commas in the sentence so that it reads as: "Maintenance requirements for measurements of battery capacity at appropriate intervals to ensure the batteries, whose function is required for safe operation of the aircraft, will perform their intended function as long as they are installed in the aircraft."	Editorial	Agree - Document updated. Disagreed. I think adding the commas as suggested changes the meaning of the sentence such that it then states that all batteries are required for safe operation.
103	AC20-184 Draft	2-8	2.9.6.4	"Scheduled servicing information to replace batteries at the manufacturer's recommended replacement time."	Comment: Replacement may be based on calendar time or capacity.	Add "if applicable."	Conceptual	Partially agreed Document Updated.

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104	AC20-184 Draft	2-8	2.9.8	"Replacement of individual cells within lithium batteries must be approved by the lithium batteries OEM and the FAA."	Comment: Does the FAA want to approve any cell replacement instruction? This should not be necessary if the battery is restored to its original qualified configuration with the same cell chemistry, size, format factor, manufacturer, part number, and capacity. Is this because of a concern that new cells are mixed with old cells?	Please clarify the specific concern that requires FAA approval of cell replacement.	Conceptual	Disagreed- The FAA must be involved in the replacement of individual cells that may result in mixing of cells. This is part of the oversight function of the FAA. This process may introduce a hazard to the battery if not evaluated properly.
105	AC20-184 Draft	3-1	3.2.1	"The electrolyte used in lithium batteries can be a highly reactive substance…."	Comment: Change to "electrolyte and cathode materials can be highly reactive substances." Temperature and current can affect electrode integrity.	Add "and cathode materials" also.	Conceptual	Agree - Document Updated
106	AC20-184 Draft	3-1	3.2.2	"To determine the life and age of the lithium battery, record the install date of the battery."	Comment: For fleet operations, it is common to move batteries between aircraft and old batteries can be moved to newer aircraft. Recommend changing to state: "record the manufacture date of the battery" instead.	Restate to "record the manufacture date of the battery."	Conceptual	Agree - Document updated
107	AC20-184 Draft	3-1	3.2.3	State of Charge: "In a normal electrical charging system, the generator or alternator restores a battery to full charge during a flight of 1 hour to 90 minutes regardless of use before flight. However, safeguards must be implemented to ensure the aircraft does not begin flight with a battery not sufficiently charged to accomplish the intended function of the lithium battery."	1) Comment: This may be true for main batteries, but may not be true for some low rate batteries. This statement is not entirely accurate and may lead to a wrong assumption. 2) Comment: May need more explicit text to correlate a dispatchable state of charge with a measurable battery characteristic such as voltage.	• Recommend deleting or clarifying the statement related to "restores a battery to full charge during a flight of 1 hour to 90 minutes." Recommend adding a statement that reading battery voltage on the aircraft is an acceptable means of determining battery state of charge if a voltage-state of charge relationship has been defined by the battery manufacturer.	Conceptual	Agree - Document updated.

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108	AC20-184 Draft	3-1	3.2.3	State of Health: “Determine the state of health of the battery by recording the following…. (i) Length of time the battery has been in service; (ii) Environmental factors…; (iii) Observed failures….”	Comment: Lead acid and Ni-Cd battery states of health are determined by capacity check. A capacity check should be given as an acceptable method for determining SOH.	Recommend adding capacity check as an acceptable means of compliance.	Conceptual	Agree - Document updated.
109	AC20-184 Draft	3-2	3.2.6	Reliability of Charging/Monitoring Systems: “Follow the manufacturer’s recommendation for maintenance inspections concerning the battery charging and monitoring systems.”	Comment: Should there be a statement related to on aircraft verification of CAS messages since this AC should also address the installation aspects?	• Recommend adding on-aircraft verification guidance as well.	Conceptual	Disagree - This verification will depend on the battery design. The statement already states to follow the manufacturer's recommendation for inspection.
110	AC20-184 Draft	3-2	3.2.8.4	“Inspect for evidence of physical damage”	Comment: Also add “heat damage/discoloration”. Corrosion and loss of insulating paint is assumed to be covered in “physical damage”.	• Recommend adding “heat damage/discoloration” to the sentence.	Conceptual	Agree - Document updated
111	AC20-184 Draft	3-3	3.3.4	“When replacing batteries, check for corrosion and moisture on the battery interfaces.”	Comment: Also check for short circuit to battery case?	Recommend adding a step to check for short circuit to battery case such as an insulation resistance test.	Conceptual	Agree - Document updated.
112	AC20-184 Draft	3-3	3.4	Aircraft Battery Storage and Handling.	Comment: Lithium batteries that are stored or are being serviced may also vent electrolyte gas/liquid. If located near other battery types, the vented electrolyte gas/liquid could contaminate other batteries.	Recommend adding guidance such as the following: “Batteries should be stored in areas that can be properly ventilated in the event of cell venting. MSDS and fire safety procedures should be available at the storage locations. Venting of Lithium batteries stored in lead acid or Ni-Cd battery storage/service areas may lead to contamination of lead acid/Ni-Cd batteries.”	Conceptual	Disagree - The manufacturer's recommended storage procedures will address the comment.

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113	AC20-184 Draft	B-4	B.2	Advisory Circulars: "RTCA Document DO-16o versions…"	Comment: Correct typo from "DO-16o" to "DO-160" (replace small 'o' with numeric zero).	Correct typo.	Editorial	Agree - Document Upadated.
114	AC20-184 Draft	C-2	C.1.11	Service Life: "Service life cannot be greater than the shelf life and will be stated by the equipment manufacturer."	Comment: Recommend keeping the terms "Service Life" and "Shelf Life" separate; DO-311 coupled these two definitions, but DO-347 recognize a possible unintended consequence and decoupled these definitions by removing the "Service Life" definition. Shelf life was arbitrarily defined as when a battery's capacity falls below 80% of rated capacity. Some batteries may have been oversized beyond the requirement of its intended application so that the battery remains usable and dispatchable even if the capacity is below 80% rated capacity. Service life may be longer than Shelf Life. Recommend that this AC not reinforce an incorrect relationship between service life and shelf life.	Recommend deleting the statement that service life cannot be greater than the shelf life.	Conceptual	Agree - Document Updated
115	AC20-184 Draft	D-1	Appendix D Requirement #1	For requirement #1, "safe cell temperatures and pressures must be maintained during any foreseeable charging or discharging condition and during any failure of the charging or battery monitoring system not shown to be extremely remote. The rechargeable lithium battery installation must preclude explosion in the event of those failures."	Comment: The Small Airplane Directorate issued SC 23-236-SC and proposed special condition (FAA-2015-0721 for Honda Jet HA-420) uses "must preclude explosion OR FIRE in the event of those failures." In many publicly reported instances of lithium battery thermal runaway, fires were more commonly reported than explosions. Therefore, it is recommended that "OR FIRE" be adopted in Requirement #1 for all aircraft categories instead of just Part 23 aircraft.	Restate Requirement #1 to include "explosion OR fire".	Conceptual	Disagree - The SC #1 is part of the published special conditions in the the NPRM. They are stated as typical special conditions and will be addressed by the applicable directorates and aircraft certification offices.

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116	AC20-184 Draft	D-3	Appendix D Requirement #8:	For requirement #8, any "rechargeable lithium battery installation…must incorporate a monitoring and warning feature that will provide an indication to the appropriate flight crewmembers whenever the state-of-charge of the batteries has fallen below levels considered acceptable for dispatch of the aircraft."	Comment: For Part 23 aircraft, the Small Airplane Directorate included "whenever the CAPACITY AND state of charge…." This additional 'Capacity' requirement may be necessary for multi-cell batteries if the battery is top charged to 100% SOC while some cells have shorted/faulted/failed/opened and are no longer contributing to the CAPACITY of the battery as expected for dispatch.	Change to state "capacity and state of charge".	Conceptual	Disagree - The SC #8 is part of the published special conditions in the the NPRM. They are stated as typical special conditions and will be addressed by the applicable directorates and aircraft certification offices.
117	AC20-184 Draft	E-4	Appendix E Small/Med Batt MoC for Requirement #7:	For requirement #7, the "rechargeable lithium battery or battery system shall have protective features to prevent unsafe conditions during operation." In Appendix E, it lists DO-311 and DO-347 sections as acceptable means of compliance, but some referenced sections may be missing.	Comment: Should the protective features be verified to be functioning properly? Should DO-347, 1.7.2 "Built In Test" be listed also?	• Determine if DO-347, 1.7.2 should also be listed.	Conceptual	Agree - Document Updated

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118	AC20-184 Draft	E-5	Appendix E Small/Med Batt MoC for Requirement #8:	For requirement #8, any "rechargeable lithium battery installation…must incorporate a monitoring and warning feature that will provide an indication to the appropriate flight crewmembers whenever the state-of-charge of the batteries has fallen below levels considered acceptable for dispatch of the aircraft." In Appendix E, it lists DO-311 and DO-347 sections as acceptable means of compliance, but some referenced sections may be missing.	1) Comment: Should DO-347, 1.5.6 "Instructions for Continued Airworthiness", "1.7.2 "Built In Test", and 3.1.1 "Warning System" be listed also? 2) Comment: A capacity check procedure should be defined in the Instructions for Continued Airworthiness so that the capacity value can be used to meet the requirement of Requirement #8.	• Determine if DO-347, 1.5.6, 1.7.2, 3.1.1 should be listed. Add a capacity check procedure in the ICA requirements.	Conceptual	Partially agree but not adopted - RTCA DO-347 1.5.6 has been taken care of in SC #9. Also RTCA DO-347 1.7.2 is taken care of in SC #7. RTCA DO-347 3.1.1 has been added.
119	AC20-184 Draft	E-5	Appendix E Small/Med Batt MoC for Requirement #9:	For requirement #9, the "ICA shall contain maintenance requirements to assure proper…operation of the rechargeable lithium batteries and battery systems…." In Appendix E, it lists DO-311 and DO-347 sections as acceptable means of compliance, but some referenced sections may be missing.	Comment: Should DO-347, 1.7.2 "Built In Test" be listed also? B.I.T. may be needed as part of the battery servicing.	Determine if DO-347, 1.7.2 should be listed.	Conceptual	Agreed but not adopted- Has been take care of in SC #7.

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120	AC20-184 Draft	F-1	Appendix F Large Batt MoC for Requirement #1:	For requirement #1, the "cells within the lithium battery system shall be designed to minimize the impact of self-sustained, uncontrolled increases in cell temperature or pressure...." In Appendix F, it lists DO-311 and DO-347 sections as acceptable means of compliance, but some referenced sections may be missing.	1) Comment: An Issue Paper levied by the FAA on a recent Part 25 lithium battery project had DO-347 1.5.1 "Battery Protective Features" listed, but it is not listed in the AC. DO-347, 1.5.1 has text which is more generic to prevent "unsafe conditions" and "minimize drain on the battery." 2) Comment: An Issue Paper levied by the FAA on a recent Part 25 lithium battery project had DO-311 1.5.2 "Precautions During Charging and Discharging" unlisted, but it is listed in the AC. DO-311, 1.5.2 is almost a repeat of Requirement #1. 3) Comment: An Issue Paper levied by the FAA on a recent Part 25 lithium battery project had DO-347 2.5 "Software and Hardware Requirements" listed, but it is not listed in the AC. 4) Comment: DO-347, 1.6 is incorrectly titled as "Design Criteria"; it should match the title in DO-347, which is "Design Requirements."	• The AC should be aligned to include/exclude sections identified in the existing unpublished issue paper. Correct the title listed for DO-347, 1.6.	Conceptual	Partially agree - RTCA DO-347 section 1.6 title is corrected. The project that is refered to is a current project MOC issued by the ACO and Directorate.

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121	AC20-184 Draft	F-2	Appendix F Large Batt MoC for Requirement #2:	For requirement #2, the "lithium battery system shall be designed to minimize the impact of self-sustained, uncontrolled increases in temperature and pressure, as a result of any failure within the battery." In Appendix F, it lists DO-311 and DO-347 sections as acceptable means of compliance, but some referenced sections may be missing.	1) Comment: An Issue Paper levied by the FAA on a recent Part 25 lithium battery project had DO-347 1.5.1 “Battery Protective Features” listed, but it is not listed in the AC. DO-347, 1.5.1 has text which is more generic to prevent “unsafe conditions” and “minimize drain on the battery.” 2) Comment: An Issue Paper levied by the FAA on a recent Part 25 lithium battery project had DO-311 1.5.2 “Precautions During Charging and Discharging” unlisted, but it is listed in the AC. DO-311, 1.5.2 is almost a repeat of Requirement #1. 3) Comment: An Issue Paper levied by the FAA on a recent Part 25 lithium battery project had DO-347 2.3.7 “Short Circuit of a Single Cell” listed, but it is not listed in the AC. 4) Comment: An Issue Paper levied by the FAA on a recent Part 25 lithium battery project had DO-347 2.5 “Software and Hardware Requirements” listed, but it is not listed in the AC. 5) Comment: DO-347, 1.6 is incorrectly titled as “Design Criteria”; it should match the title in DO-347, which is “Design Requirements.”	• The AC should be aligned to include/exclude sections identified in the existing unpublished issue paper. Correct the title listed for DO-347, 1.6.	Conceptual	Partially agree - The project that is refered to is a current project MOC issued by the ACO and Directorate.
122	AC20-184 Draft	F-3	Appendix F Large Batt MoC for Requirement #3:	For requirement #3, the battery systems "shall be capable of containing or safely relieving the maximum pressure buildup that can occur under worst-case conditions...." In Appendix F, it lists DO-311 and DO-347 sections as acceptable means of compliance, but some referenced sections may be missing.	1) Comment: An Issue Paper levied by the FAA on a recent Part 25 lithium battery project had DO-347 2.3.7 “Short Circuit of a Single Cell” listed, but it is not listed in the AC. 2) Comment: An Issue Paper levied by the FAA on a recent Part 25 lithium battery project had DO-347 3.2 “Safety Considerations for Installed Equipment” listed, but it is not listed in the AC.	• The AC should be aligned to include/exclude sections identified in the existing unpublished issue paper.	Conceptual	Disagree - The project that is refered to is a current project MOC issued by the ACO and Directorate.

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123	AC20-184 Draft	F-3	Appendix F Large Batt MoC for Requirement #4:	For requirement #4, the "internal and external materials of the rechargeable lithium battery and battery system shall meet the applicable certification flammability requirements of the installation...." In Appendix F, it lists DO-311 and DO-347 sections as acceptable means of compliance, but some referenced sections may be missing.	1) Comment: An Issue Paper levied by the FAA on a recent Part 25 lithium battery project had DO-347 2.1 “Test Conditions and Apparatus” listed, but it is not listed in the AC.	The AC should be aligned to include/exclude sections identified in the existing unpublished issue paper.	Conceptual	Disagree - This AC did not intend to reference all the MOC IP released or being worked on currently.
124	AC20-184 Draft	F-4	Appendix F Large Batt MoC for Requirement #5:	For requirement #5, there shall be "no damage to surrounding structure or any adjacent systems…."In Appendix F, it lists DO-311 and DO-347 sections as acceptable means of compliance, but some referenced sections may be missing.	1) Comment: An Issue Paper levied by the FAA on a recent Part 25 lithium battery project had DO-347 2.3.7 “Short Circuit of a Single Cell” listed, but it is not listed in the AC.	The AC should be aligned to include/exclude sections identified in the existing unpublished issue paper.	Conceptual	Disagree - The project that is refered to is a current project MOC issued by the ACO and Directorate.
125	AC20-184 Draft	F-5	Appendix F Large Batt MoC for Requirement #6:	For requirement #6, the "lithium battery system shall be designed to minimize the impact of self-sustained, uncontrolled increases in temperature or pressure...." In Appendix F, it lists DO-311 and DO-347 sections as acceptable means of compliance, but some referenced sections may be missing.	1) Comment: An Issue Paper levied by the FAA on a recent Part 25 lithium battery project had DO-347 3.1 “Equipment Installation” listed which included 3.1.1, 3.1.2, 3.1.3, 3.1.4, and 3.1.5. But the AC only listed 3.1.5 “Additional Equipment Installation Considerations,” which appropriately discussed thermal cooling to mitigate Requirement #6’s heat effects on surrounding structure.	• The AC should be aligned to include/exclude sections identified in the existing unpublished issue paper.	Conceptual	Disagree - The project that is refered to is a current project MOC issued by the ACO and Directorate.

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126	AC20-184 Draft	F-6	Appendix F Large Batt MoC for Requirement #7:	For requirement #7, the "rechargeable lithium battery or battery system shall have protective features to prevent unsafe conditions during operation." In Appendix F, it lists DO-311 and DO-347 sections as acceptable means of compliance, but some referenced sections may be missing.	1) Comment: Should the protective features be verified to be functioning properly? Should DO-311, 1.5.7 “Warning System” and/or DO-347, 1.7.2 “Built In Test” be listed also?	• Determine if DO-311, 1.5.7 and/or DO-347, 1.7.2, should be listed.	Conceptual	Agree - Document Updated.
127	AC20-184 Draft	F-6	Appendix F Large Batt MoC for Requirement #8:	“Any rechargeable lithium battery installation…must incorporate a monitoring and warning feature that will provide an indication to the appropriate flight crewmembers whenever the state-of-charge of the batteries has fallen below levels considered acceptable for dispatch of the aircraft.” In Appendix F, it lists DO-311 and DO-347 sections as acceptable means of compliance, but some referenced sections may be missing.	1) Comment: Should DO-347, 1.5.6 “Instructions for Continued Airworthiness” be listed also? 2) Comment: Should DO-311, 1.5.7 “Warning System” and/or DO-347, 1.7.2 “Built In Test”/3.1.1 “Warning System” be listed also? 3) Comment: A capacity check procedure should be defined in the Instructions for Continued Airworthiness so that the capacity value can be used to meet the requirement of Requirement #8.	• Determine if DO-347, 1.5.6 and/or DO-311, 1.5.7 should be listed. Add a capacity check procedure in the ICA requirements.	Conceptual	Partially agree - MOC for SC#9 already addressed ICA. RTCA DO-311 1.5.7 is added.Capacity check procedure will be addressed by the ICA.

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128	AC20-184 Draft	F-7	Appendix F Large Batt MoC for Requirement #9:	"The ICA shall contain maintenance requirements to assure proper…operation of the rechargeable lithium batteries and battery systems…." In Appendix F, it lists DO-311 and DO-347 sections as acceptable means of compliance, but some referenced sections may be missing.	1) Comment: Should DO-311, 1.5.7 "Warning System" and/or DO-347, 1.7.2 "Built In Test" be listed also? B.I.T. may be needed as part of the battery servicing. 2) Comment: An Issue Paper levied by the FAA on a recent Part 25 lithium battery project had DO-347 "Instructions for Continued Airworthiness" listed, but it is not listed in the AC.	Determine if DO-311, 1.5.7 and/or DO-347, 1.7.2 and "Instructions for Continued Airworthiness" should be listed.	Conceptual	Partially Agree - RTCA DO-311 1.12 already addresses ICA.BIT test is addressed by MOC SC#7.
129	Draft Advisory Circular AC 20-184 "*Guidance on Testing and Installation of Rechargeable Lithium Battery and Battery Systems on Aircraft*"	All	0 General		DO-311 and DO-347 is scheduled to be superseded by DO-311A in the very near future. (DO-311A should be published prior to July 1, 2015.) It would be unfortunate to release guidance that was outdated within days of (or possibly even before) its release.	Replace the requirements of DO-311 ***AND*** DO-347 with a single reference to those of DO-311A. We would strongly recommend that the publication of this AC be delayed until the availability of DO-311A and that those requirements be incorporated in the recommended means of compliance in lieu of DO-311 and DO-347.	Conceptual	Agree with modification - Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's
130	Draft Advisory Circular AC 20-184	ii	Table of Contents	Appendix G	Appendix G is misidentified in the Table of Contents. Appendix H is missing.	Appendix G should refer to the *Lithium Battery Means of Compliance Certification Process Flow Chart* . Appendix H (if included in the final release) should refer to the *Advisory Circular Feedback Information* .	Editorial	Agreed- Table and page is updated.
131	Draft Advisory Circular AC 20-184	1-1	1.2.1.5	The introduction of 1.2.1 states "Chapter 2 of this AC applies to the certification of installed lithium batteries on aircraft"	It is our understanding that PMA is not an installation approval.	Remove 1.2.1.5	Conceptual	Disagree - PMA is design, production and installation approved part.
132	Draft Advisory Circular AC 20-184	1-1	1.2.1	Note: The guidance can be used for any FAA process to approve installation lithium batteries.	Appears to be missing the word "of" and possibly "the"	"… FAA process to approve ***the*** installation ***of*** lithium batteries."	Editorial	Agree - Document updated.

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133	Draft Advisory Circular AC 20-184	1-1	1.2.3	"… the means of compliance…"	This statement implies that there is only one means of compliance (as prescribed in this AC). Since there may be others, we recommend: (see Prposed Resolution)	"… the means of compliance prescribed in this AC."	Conceptual	Agreed- Document updated.
134	Draft Advisory Circular AC 20-184	1-3	1.4.2.2	Discharge of some types of lithium batteries beyond a certain voltage (typically 2.4 volts) …	2.4 volts is specific to a particular chemistry.	Remove parenthetical comment.	Conceptual	Agree - Document updated.
135	Draft Advisory Circular AC 20-184	1-3	1.4.2.4	Undetected internal defects within a battery have	Internal defects in this context refer to the cell, not the battery (system).	Suggest "cell" instead of "battery"	Conceptual	Agree - Document updated.
136	Draft Advisory Circular AC 20-184	2-1	2.2.1	entire section	This information is redundant and unnecessary due to the lack of unique information associated with lithium-ion battery systems. That is, this is the same requirements associated with any installation certification program and plan.	Remove or simplify to a single statement recommending inclusion of lithium aspects to the certification plan.	Conceptual	Disagree - This information is indeed repeated due to it's importance and is consistent with the other FAA requirements and guidance.
137	Draft Advisory Circular AC 20-184	2-2	Table 1	entire table	These are regulations which must be met for any installation. A list of regulations is redundant and unnecessary (and potentially incomplete). It is also confusing to understand why these are here and how to show compliance to them within the scope of this AC.	Remove Table 1 and it's reference in 2.2.2.1 on page 2-1	Conceptual	Disagree - This information is indeed repeated due to it's importance and is consistent with the other FAA requirements and guidance
138	Draft Advisory Circular AC 20-184	2-4	2.3.2	Follow the guidance in appendix E to this AC for very small, small, and medium lithium batteries, and the guidance in appendix F for large lithium batteries	With the use of DO-311A, size differentiation is not recognized (except for very small). Suggest simplifying the document significantly with the application of DO-311A. Note that there is no reference to Very Small batteries in Appendix E, only Appendix A.	Reword 2.3.2 accordingly. Combine Appendix E and F.	Conceptual	Disagree - This AC can only address existing published and released documents. Agreed with modification- Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's

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139	Draft Advisory Circular AC 20-184	2-4	2.3.3	Ground and Flight Tests	Although written as "should", the specific inclusion as written will typically dictate ground and flight tests. We recommend a more application-specific approach.	Combine 2.3.3.1-3 into a single paragraph that states something like the following: Each installation should be evaluated as to whether ground and/or flight tests are required as part of the certification plan. Ground and/or flight testing should evaluate performance, effects on or by the aircraft, and electromagnetic compatibility.	Conceptual	Agree with modification- Doucment updated to clarify flight test based on FAA evaluation.
140	Draft Advisory Circular AC 20-184	2-5	2.4	System Safety Assessment	These requirements are not specific or unique to lithium-ion battery systems and are required for any installation certification.	Strike this section or reduce it to a single statement with reference to applicable regulations or other AC which identifies the requirement for an SSA.	Conceptual	Disagree - This information is indeed repeated due to it's importance and is consistent with the other FAA requirements and guidance.
141	Draft Advisory Circular AC 20-184	2-6	2.7	State of Charge	This statement is not true. (SOC degrades at a higher rate when maintained at a higher state of charge) Nor does the comment regarding overcharging particularly apply. This section does not seem to be necessary or add to the usefulness of the document.	Suggest removing this section.	Conceptual	Agree with modification - Document updated based on other comments as well.
142	Draft Advisory Circular AC 20-184	2-6	2.8	Flammability	There is no caveat mentioned for the cells themselves (or their internal materials) which are flammable.	Suggest noting that the cells themselves are not subject to the regulations/requirements for flammability (during failure) or make reference to the applicable section of DO-311A that addresses this topic (preferred).	Conceptual	Agree with modification - Clariifed that the statement is dealing with aircraft batteries and not cell or cells within a battery.

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143	Draft Advisory Circular AC 20-184	3-1	3.2	Aircraft Battery Maintenance	Prescription of maintenance procedures should not be regulated by the AC. It is sufficient to identify the manufacturer's maintenance instructions and suggest topics that may be included.	Replace 3.2 with the following: "Battery maintenance must be accomplished in accordance with the battery manufacturer's instructions. Battery maintenance instructions should include, but is not limited to items which address age, storage, state of charge/health, physical integrity, proper monitoring systems, shop procedures and inspection methods.	Conceptual	Agree with modification - This has been address in section 3.2. The OEM maintenance procedures were addressed and is not limited to this list.
144	Draft Advisory Circular AC 20-184	3-2	3.3	Aircraft Battery Replacement	Prescription of replacement procedures should not be regulated by the AC. It is sufficient to identify the manufacturer's replacement instructions and suggest topics that may be included.	Replace 3.3 with the following: "Battery replacement must be accomplished in accordance with the battery manufacturer's instructions."	Conceptual	Partially agree - The recommendation is already addressed in section 3.3.1
145	Draft Advisory Circular AC 20-184	3-3	3.4	Aircraft Battery Storage and Handling	Prescription of storage and handling procedures should not be regulated by the AC. It is sufficient to identify the manufacturer's instructions and suggest topics that may be included.	Replace 3.4 with the following: "Storage and handling of lithium batteries or battery systems must be accomplished in accordance with the battery manufacturer's instructions. Particular consideration should be given to storage temperature, recharge frequency and procedures, safety precautions, and protection from physical damage."	Conceptual	Partially agree - The recommendation is already addressed in section 3.4.
146	Draft Advisory Circular AC 20-184	A-1	Table A-1	Acceptable Means of Compliance column	There is no differentiation between small, medium and large in DO-311A.	Combine the comments in the Acceptable Means of Compliance column for small/medium with large. Change reference from DO-347 to DO-311A.	Conceptual	Partially agree - The AC has to address the current existing released standard including RTCA DO-311 and RTCA Do-347. Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's

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147	Draft Advisory Circular AC 20-184	D-1	Special Condition #1	The cells within the lithium battery system shall be designed to minimize the impact of self‑sustained, uncontrolled increases in cell temperature or pressure, as a result of any foreseeable charging or discharging condition. The probability of this event must be shown to be extremely remote (1 event in 10 million (1x10-7) flight hours).	This special condition should apply to the battery system and its ability to maintain the safe operating environment for the cells within. The intent statement should focus on the ability of the system to meet this requirement, not the cells themselves. Additionally, showing analysis that the cells can meet an extremely remote requirement may be difficult or impossible due to information available from the cell manufacturer or the challenge of the actual cell manufacturing process to demonstrate such reliability.	"The battery system shall be designed to properly maintain and operate the cells such that it minimizes the potential for self-sustained, uncontrolled increases in cell temperature or pressure, as a result of any foreseeable charging or discharging condition. Failure of the charging and battery monitoring features must be shown to be extremely remote (1 event in 10 million flight hours ($1x10^{-7}$)).	Conceptual	Disagree - The SC #1 is part of the published special conditions in the the NPRM. They are stated as typical special conditions and will be addressed by the applicable directorates and aircraft certification offices.
148	Draft Advisory Circular AC 20-184	D-1	Special Condition #1	It must preclude explosion in the event of any failure.	It cannot "preclude". (i.e. prevent from happening)	"It must contain the potential for explosion in the event of a failure."	Conceptual	Disagree - The SC #1 is part of the published special conditions in the the NPRM. They are stated as typical special conditions and will be addressed by the applicable directorates and aircraft certification offices.
149	Draft Advisory Circular AC 20-184	D-1	Special Condition #2	The probability of impact must be extremely improbable (1 event in 1 billion ($1x10^{-9}$) flight hours).	This is not a requirement of the special condition. Nor is "impact" defined. The potential for thermal runaway which is contained or vented would not meet this requirement.	Replace this statement with: "Demonstrated results per the means of compliance within this AC shall validate an appropriate mitigation and impact of failure."	Conceptual	Disagreed- The demostration test and validation is provided in the appendix for MOC for SC#2. It is consistent with your proposed resolution.
150	Draft Advisory Circular AC 20-184	D-1	Special Condition #3	The battery system shall not emit any explosive or toxic gases, smoke, or fluids during normal operation except through designed venting provisions.	Lithium batteries do not emit during normal operations (only as a condition of failure).	"The battery system shall not emit any explosive or toxic gases, smoke, or fluids during normal operation. Any emissions as a result of an internal failure must exit through designed venting provisions" (or, omit the second sentence since it is stated in the next paragraph of the AC)	Conceptual	Disagree - The SC #3 is part of the published special conditions in the the NPRM. They are stated as typical special conditions and will be addressed by the applicable directorates and aircraft certification offices.

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151	Draft Advisory Circular AC 20-184	D-2	Special Condition #3	The probability of this failure must be shown to be extremely remote (1 event in 10 million ($1x10^{-7}$) flight hours).	Similar to our response for SC#1, this statement is not clear as to WHAT needs to be $1x10^{-7}$. As the SC reads, emission of explosive or toxic gases is not the failure in question. It should be the failure of battery charging, monitoring or installation that *leads* to emission of gases. (as an example, it may be difficult or impossible to guarantee $1x10^{-7}$ for an internal manufacturing defect of the cell that could lead to emissions. Therefore, it is the battery systems around the cell that must meet this.)	"Failure of the charging and battery monitoring features must be shown to be extremely remote (1 event in 10 million flight hours ($1x10^{-7}$))."	Conceptual	Disagree - The demostration test and validation is provided in the appendix for MOC for SC#3.
152	Draft Advisory Circular AC 20-184	D-2	Special Condition #4	Installations of rechargeable lithium batteries must meet the requirements of Title 14 of the Code of Federal Regulations (14 CFR) 23/25/27/29.863(a) through (d) for parts 23, 25, 27, and 29.	This is a re-statement of existing installation requirements in the current CFRs. It does not need to exist as a redundant/specific special condition.	Remove Special Condition #4.	Conceptual	Disagree - The SC #4 is part of the published special conditions in the the NPRM. They are stated as typical special conditions and will be addressed by the applicable directorates and aircraft certification offices.
153	Draft Advisory Circular AC 20-184	D-3	Special Condition #7	(i) A battery temperature sensing and over-temperature warning system …, or (ii) A battery failure sensing and warning system…	This has been a point of contention amongst members of the industry in the past. Is a "warning system" required if the battery manages itself and has automatic charge rate (and/or disconnect) control? Particularly for non-essential batteries, a warning system would appear unnecessary. Other elements of the regulations would drive a warning or annunciation requirement if it was part of a critical system.	(i) A battery temperature sensing system with a means for automatically disconnecting the battery from its charging source in the event of an over temperature condition, or (ii) A battery failure sensing system with a means for automatically disconnecting the battery from its charging source in the event of battery failure.	Conceptual	Disagree - The SC #3 is part of the published special conditions in the the NPRM. They are stated as typical special conditions and will be addressed by the applicable directorates and aircraft certification offices.
154	Draft Advisory Circular AC 20-184	D-1..D-3	Appendix D	Special Conditions	It would appear that many of the special conditions are essentially the same as regulations found in 2x.1353. Is it possibly to reduce the number of special conditions based on overlap or redundancy? Some current requirements from 1353 are not chemistry specific and would appear to already apply to all batteries.	Remove special conditions which are a direct (or near-direct) re-statement of existing regulations.	Conceptual	Disagree - The SC #3 is part of the published special conditions in the the NPRM. They are stated as typical special conditions and will be addressed by the applicable directorates and aircraft certification offices.

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155	Draft Advisory Circular AC 20-184	E-1	Appendix E	(all)	Appendix E and F should have the same means of compliance if DO-311A is used as the standard.	Expand the title/scope of Appendix E to all but Very Small batteries and use DO-311A sections/tests as the MoC. Remove Appendix F.	Conceptual	Agree - with modification- Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's
156	Draft Advisory Circular AC 20-184	E-1	Appendix E	(all)	It would be more succinct to either reference Section 1 requirements or Section 2 tests from DO-311A, instead of both. Based on the cross-reference within Appendix B of DO-311A, complying with Section 2 automatically demonstrates compliance to Section 1. Listing both may be confusing to a large portion of the industry.	Include either Section 1 requirements from DO-311A -OR- Section 2 requirements/tests, but not both.	Conceptual	Agree with modification- Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's
157	Draft Advisory Circular AC 20-184	F-1	Appendix F	(all)	While reference to DO-311 is theoretically useful as a reference for those products which were designed/certified/tested prior to this AC, if a new standard is required (DO-347 or DO-311A), then there is little use in noting DO-311 requirements. Those wishing to apply previous DO-311 test results can attempt to show similarity by analysis to current requirements as applicable.	Remove references to DO-311 tests/sections.	Conceptual	Agree - with modification- Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's
158			1.1.1		Suggest adding a reference to DO-311A as this will shortly replace / supersede DO-347		Conceptual	Agree - The AC has to address the current existing released standard including RTCA DO-311 and RTCA Do-347. Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's
159			1.1.1		As DO-311A does not differentiate between battery sizes, there is a potential problem with proportionality of this AC if DO-347 really is superseded by DO-311A because it could be that the FAA then decides to treat all batteries equally.		Conceptual	Agree - The AC has to address the current existing released standard including RTCA DO-311 and RTCA Do-347. Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's

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160			1.1.1		This AC needs to be re-drafted using only DO-311A and needs to have clearer, proportionate, and unambiguous guidance.		Conceptual	Partially agree - The AC has to address the current existing released standard including RTCA DO-311 and RTCA Do-347. Note was added to document to have the option to use RTCA DO-311A by the directorates and ACO's
161			1.1.1		This proposed AC states it provides an “acceptable means of compliance” to associated regulation that does not exist. It cites only the general CFR parts as the relevant regulation. It declares the current regulation within 14 CFR 23 / 25 / 27 / 29 as inadequate, and then provides its own regulation as proposed special conditions contained within an appendix which is to be applied by the directorates under 14 CFR 21.16. This proposed AC effectively contains its own rule to replace current regulation. As such this document is an example of “rule making by AC” which is against FAA regulatory policy.		Conceptual	Disagree - 14 CFR 23/25/27 and 29.1353 do not adequately address lithium battery installation. The AC provides a list of typical special conditions. The intent of the AC is to provide a means of compliance to the special condition and not create any regulations.

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162			3.2.5		There is a lack of clarity as to how to meet several of the requirements since neither the AC nor the referenced DO documents include guidance about how to establish what is a hazardous level of emitted gas, etc. e.g., the following comment was made on the draft AC paragraph 3.2.5 guidance: “This is a big issue. When should a battery be vented and when it is ok not to vent? Does it depend on battery size? Quantity and type of emitted gasses? Other factors? DO-311/A and DO-347 are mute on this subject. The manufacturer of the battery system and installer really have no scientific basis to make this decision other than their own internal data and judgement.”		Conceptual	Disagree- This evaluation would depend on a project by project basis and need to be coordinated with the respective ACO.
163			General Table 1		Similar comments are made on other paragraphs; e.g., how does one determine a battery will be able to meet the 1x10-7 / flight hour failure rate specified in Appendix D Special Condition Requirement #3? Furthermore, why would there even be an expectation that a special condition would have to be levied on a very small, small, and perhaps even medium size battery? Special Conditions are an inefficient use of resources for both FAA and industry.		Conceptual	Disagree - Inservice events have proven that levying these Lithium Battery SC requirements are mandatory to ensure proper installation and retaining the same level of safety the current CFR provides for all other technologies.
164			Table 1		In accordance with 14 CFR 21.16, Special Conditions are imposed on individual certification programs. In our opinion, the AC is being used to effectively impose proposed regulation in circumvention of the proper regulatory process – this is an improper use of the advisory circular document.		C	Disagree - This AC does not impose these special conditions. The intent of the AC is to provide a means of compliance to the special condition and not create any regulations.AC by defintion is not regulatory.

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165			1.1.1 1.2.1 Table 1		Burden Caused by Blanket Imposition of Special Conditions: The proposed AC makes the statement: "14 CFR 23/25/27 and 29.1353 do not address lithium battery installation. Therefore special conditions will be imposed by the specific directorates to meet the equivalent airworthiness requirement of 14 CFR parts 23, 25, 27 and 29." The proposed AC further lists itself applicable to all use of lithium batteries including but not limited to: a) Emergency lighting; b) Cockpit voice recorders, flight data recorders, and underwater locator beacons; c) Main batteries for standby or emergency power; d) Auxiliary power units (APU) or main starting batteries; and e) Special functions batteries (such as flashlights, electronic equipment, life vests, safety equipment, avionics equipment, communications equipment, and emergency medical equipment). In many cases the lithium batteries in these devices already conform to FAA TSOs which specifically address lithium batteries (e.g. TSO-C179 "Permanently		C	Disagree - 14 CFR 23/25/27 and 29.1353 do not adequately address lithium battery installation. The AC provides a list of typical special conditions. The intent of the AC is to provide a means of compliance to the special condition and not create any regulations. This AC does not impose these special conditions. The intent of the AC is to provide a means of compliance to the special condition and not create any regulations.AC by defintion is not regulatory. Regardless of whether an article has a TSO or not, the installation must meet all the airworthiness regulations of the product.Part of the airworthiness of the installation may be met by the TSO.

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166			1.2.1		Additional Burden caused by the imposition of a special conditions: When a new special condition is imposed on a certification project, it requires a change to the certification basis for either the Type Certificate (TC) or the Supplementary Type Certificate (STC). A project for which a change to the certification basis is required becomes by default a "significant change" under 14CFR 21.101. This has the potential to raise any other changes which occur under the project to the latest certification amendments – even though the project might not otherwise be considered a major or significant modification.		C	Disagree- 14 CFR 23/25/27 and 29.1353 do not adequately address lithium battery installation. The AC provides a list of typical special conditions. The intent of the AC is to provide a means of compliance to the special condition and not create any regulations.
167			Table 1		Typical Special Condition and Intent: Special Condition Requirements #1 through #8 seem to parallel §§27/29.1353 requirements for general and Nickel Cadmium batteries, and therefore seem to appropriately provide an equivalent level of safety to the rule as required by §21.16, However requirement #9 appears to overstep the bounds and seems more appropriate to a means-of-compliance than something regarding this level of specificity particular to a technology embodied in regulation. If safety of any technology is dependent on maintenance procedures, then those procedures are required in the maintenance manual. Why is this required to be specifically embodied in regulation in this fashion? This would seem excessive and beyond the scope of what is otherwise embodied in regulation.		Conceptual	Disagree - 14 CFR 23/25/27 and 29.1353 do not adequately address lithium battery installation. The AC provides a list of typical special conditions. The intent of the AC is to provide a means of compliance to the special condition and not create any regulations.

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168	Garmin		General		Garmin comments that follow identify a number of significant issues with this draft AC including a lack of proportionate guidance for the various battery sizes, unquantified levels of “explosive or toxic gases, smoke, or fluids” that must lead to the use of “designed venting provisions”, the potential for over-application of special conditions and varying special conditions within directorates, references to soon-to-be superseded industry standards, etc	FAA should work with industry to draft an AC that appropriately addresses these issues and then the draft AC should be re-published for public comment.	Conceptual	Noted-The RTCA DO-311 and DO-347 are industry documents referenced in this AC. This AC is planned to be revised when DO-311A is approved
169	Garmin		General		As written, this AC treats all battery sizes as having the same hazard. This is clearly not the case in practice as transport aircraft are operated every day with hundreds of personal devices that include lithium batteries in the cabin area. Pilots of transport and GA aircraft also have personal devices in the cockpit in the form of tablet and laptop computers, cell phones, etc. that use lithium batteries. Consequently, the FAA has already made at least an implied determination that some lithium batteries have no safety effect on the aircraft because of the many personal devices that are allowed in both the cockpit and the cabin. This determination needs to be formalized across the range of battery sizes.	This AC, as well as related material such as TSO-C179a, DO-311 and later revisions, need to be revised to define a proportionate level of certification requirements based on battery size. Without this, there will be an expectation that very small (that do not meet UL 1642, UL 2054, or IEC 62133), small, and medium size batteries must have essentially the same level of testing, venting, special conditions applied, etc. This is inconsistent with the way that FAA treats other functions and their hazards.	Conceptual	Noted- The standard noted in this AC does take into account the proposal that you state. Directorates are also given some discretion in evaluating Special Conditions. The AC does not treat all hazards as the same; however, it does try to evaluate the effects of the hazard based on lithium content. The tests will document the effects. The Portable equipment are outside the scope of this AC.

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	Garmin		General		RTCA SC-225 is planned to release DO‑311A to cancel and supersede DO-311 and potentially DO-347. Additionally, DO-311A will provide no real differentiation between battery sizes.	It is suggested to only reference DO-311 or later revisions to correspond with TSO‑C179a and the current work of RTCA SC-225.	Conceptual	Agree with modification- Note was added (pg A-1) referencing use of RTCA DO-311A (when approved).
170	Garmin	Page 2-2	Paragraph 2.2.2.1,Table 1		The Table 1 title begins with “Airworthiness Regulations”. The referenced 21.31, 21.33, and 21.50(b) regulations are not “airworthiness regulations”.	Either remove the referenced 21.31, 21.33, and 21.50(b) regulations from Table 1 or remove “Airworthiness” from the Table 1 title.	Conceptual	Agree -Document updated.
171	Garmin	Page 2-4	Paragraph 2.2.2		Includes “A typical special condition and intent is provided in Appendix D and a typical MOC for the special condition is provided in Appendices E and F. Each directorate will provide guidance for their respective products. The requirement for the installation of lithium batteries on aircraft will be similar for all 14 CFR parts; however, the means of compliance to the requirement may be different for each directorate.” Allowing “each directorate” to “provide guidance for their respective products” and “means of compliance to the requirement” has the potential to cause products like standby instruments with backup batteries that are developed for installation in multiple aircraft parts to be subject to varying requirements simply because the directorate develops different guidance and means of compliance. This is problematic for equipment manufacturers who may be subject to redesign, retest, responding to multiple issue papers, etc. without any real safety benefit.	The directorates should coordinate and define the guidance and means of compliance that publicly identifies the common and/or differing expectations so that manufacturers can know from the start what the requirements are for their target market(s).	Conceptual	Agree with modification- Each directorate is indeed responsible for their product. Paragraph 2.2.2.2 includes the statement, “Each directorate should verify the applicability of these acceptable means of compliance for their respective products based on risk.” This statement is meant to apply appropriate measures based on risk-based decision making based on safety benefit.

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172	Garmin	Page 2-4	Paragraph 2.3.1.1.1		References “RTCA/DO-160G, *Environmental Conditions and Test Procedure for Airborne Equipment* , dated December 8, 2010, or the most recent revision”. This reference is inconsistent with AC 21-16G, which allows the use of earlier revisions.	Suggest changing this paragraph to reference “AC 21-16G, *RTCA Document DO-160 versions D, E, F, and G, “Environmental Conditions and Test Procedures for Airborne Equipment,* dated June 22, 2011, or the most recent revision;” to allow other DO-160 versions to be used.	Conceptual	Disagree - This AC is one means of guidance for compliance to the SC. Alternate means of compliance can be addressed by the ACO.
173	Garmin	Page 2-4	Paragraph 2.3.2		The heading “Means of Compliance Testing and Validation” seems to indicate that the means of compliance should be tested and validated.	Suggest revising the heading to: “Means of Compliance, Testing, and Validation” (i.e., add commas after “Compliance” and “Testing”).	Editorial	Agree - Document updated.
174	Garmin	Page 2-4	Paragraph 2.3.2		This paragraph indicates appendix E and appendix F provide guidance to show compliance with airworthiness regulations “and any special conditions imposed by the directorates.” Special Conditions are a very inefficient use of resources for both the FAA and industry. A special condition imposed on a certification project requires a change to the certification basis for either the TC or STC. By default, a project for which a change to the certification basis is required also becomes a “significant change” under 14CFR 21.101. This has the potential to raise any other changes which occur under the project to the latest certification amendments – even though the project might not otherwise be considered a major or significant modification.	Redraft the AC to narrow its scope to only issues related to the safety effects at the aircraft level. Additionally, limit the Special Conditions to testing and installation of “Large” Battery Systems absent evidence of safety concerns for batteries smaller than this.	Conceptual	Disagree - The intent of this AC is to cover all installed rechargeable lithium battery and battery systems on aircraft. The Special condition is a requirement under the FAR part and not a MOC as the comments states.

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175	Garmin	Page 2-5	Paragraph 2.3.3.2		The sentence: “Ground and flight tests should be performed to demonstrate that the lithium batteries installed on the aircraft will not have any adverse effect on the aircraft.” is an impossible requirement, and may lead to endless ‘what if’ scenarios.	Replace the word “will” with “do”, similar to Paragraph 2.3.3.3.	Editorial	Agree - Document updated.
176	Garmin	Page 2-6	Paragraph 2.5 and 2.5.5		Includes the statement “Any lithium batteries that use software must comply with RTCA/DO-178C, Software Considerations in Airborne Systems and Equipment Certification.” As written, this statement is inconsistent with FAA AC 20-115C which allows previous DO-178 revisions to be used provided other conditions within AC 20-115C are met.	Change this statement to “AC 20-115C, Airborne Software Assurance, defines an acceptable means for showing compliance with the applicable airworthiness regulations for the software aspects of airborne systems and equipment certification.” Then delete paragraph 2.5.5	Conceptual	Agree - Document updated.
177	Garmin	Page 2-6	Paragraph 2.5 and 2.5.1 through 2.5.4		Paragraph 2.5 is about software and includes the statement “You can find additional guidance in the following ACs:” But the ACs referenced in paragraphs 2.5.1 through 2.5.4 are not specifically related to software and seem to be more related to system safety.	Suggest deleting the quoted statement in paragraph 2.5, creating a new system safety paragraph, and moving the 2.5.1 through 2.5.4 references to the new system safety paragraph	Conceptual	Agree with modification - The sub paragraphs under section 2.5 were moved to the system safety assessment paragraph in section 2.4
178	Garmin	Page 2-6	Paragraph 2.7		The state of charge is only one aspect of battery health that must be monitored.	Suggest revising the title from “State of Charge” to “Health Monitoring”.	Conceptual	Agree - Document updated.
179	Garmin	Page 2-6	Paragraph 2.9.1		Paragraph 2.9.1 seems to imply that the ICA must be completed in accordance with all of the regulations that follow. But this implication is not appropriate. For example, 14 CFR parts 25.1709 and 25.1729 do not apply to part 23, 27, or 29 products, nor do they necessarily apply to a 14 CFR part 25 product that does not include EWIS it its certification basis.	Suggest revising the sentence to: “During the certification process of the lithium batteries, complete the ICA in accordance with the following regulations as applicable to the certification basis of the product.”	Conceptual	Agree - Document updated.

For detailed instructions on how to fill out the columns below, please see the Instructions sheet.

Comments Submitted By:	Norm Pereira, AIR-130 Branch, Section 133
Organization:	Dukane Seacom (1), Sierra Nevada Corp. (2-6), Robinson Helicopter Co. (7-41), The Boeing Company (42-72), Underwriters Laboratories Inc. (73-86)
	AIRBUS (87-92), Cessna (93-128), True Blue Power (129-157), GAMA (158-167), Tech Center Gus 168-169)
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180	Garmin	Page 3-2	Paragraph 3.2.5		Includes statements that relate to ICA for battery venting. However, FAA provides no explanation as to how to quantify what constitutes hazardous quantities of explosive or toxic gases, smoke, or fluids that must lead to the use of venting. Transport aircraft are operated every day with hundreds of personal devices that include lithium batteries in the cabin area. Pilots of transport and GA aircraft also have personal devices in the cockpit in the form of tablet and laptop computers, cell phones, etc. that use lithium batteries.	The FAA needs to determine at what size a lithium battery can release hazardous quantities of explosive or toxic gases, smoke, or fluids that must lead to the use of venting. The FAA has already made at least an implied determination that some lithium batteries do not require venting because of the many personal devices that are allowed in both the cockpit and the cabin. This determination needs to be extended across the range of battery sizes.	Conceptual	Agree with modification - Appendix E, Special Condition #3, reference to DO-347 section 1.6.2 modified to state, “Venting Provisions. For a Small/Medium battery, it is acceptable to vent into the surrounding battery container if meeting the provisions of this section.”

For detailed instructions on how to fill out the columns below, please see the Instructions sheet.

Comments Submitted By:	Norm Pereira, AIR-130 Branch, Section 133
Organization:	Dukane Seacom (1), Sierra Nevada Corp. (2-6), Robinson Helicopter Co. (7-41), The Boeing Company (42-72), Underwriters Laboratories Inc. (73-86)
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181	Garmin	Page A-1	Acceptable Means of Compliance column		The Acceptable Means of Compliance column for the various battery sizes includes statements referring to references appendix E and appendix F as providing guidance for an acceptable means of compliance for the special condition requirements. Special Conditions are a very inefficient use of resources for both the FAA and industry. A special condition imposed on a certification project requires a change to the certification basis for either the TC or STC. By default, a project for which a change to the certification basis is required also becomes a “significant change” under 14CFR 21.101. This has the potential to raise any other changes which occur under the project to the latest certification amendments – even though the project might not otherwise be considered a major or significant modification.	Redraft the AC to narrow its scope to only issues related to the safety effects at the aircraft level. Additionally, limit the Special Conditions to testing and installation of “Large” Battery Systems absent evidence of safety concerns for batteries smaller than this.	Conceptual	Noted - The intent of this AC is to cover all installed rechargeable lithium battery and battery systems on aircraft. The AC attempts to incorporate risk-based decision making.
182	Garmin	Page B-2	Appendix B		The Appendix B title should have a page break so that it begins on page B-1 and so that Appendix A ends on page A-2.	Add a page break and ensure the page numbering is correct.	Format	Agree - Format updated.

For detailed instructions on how to fill out the columns below, please see the Instructions sheet.

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183	Garmin	Page D-1	Appendix D		Appendix D defines typical special conditions to be applied. Special Conditions are a very inefficient use of resources for both the FAA and industry. A special condition imposed on a certification project requires a change to the certification basis for either the TC or STC. By default, a project for which a change to the certification basis is required also becomes a “significant change” under 14CFR 21.101. This has the potential to raise any other changes which occur under the project to the latest certification amendments – even though the project might not otherwise be considered a major or significant modification.	Redraft the AC to narrow its scope to only issues related to the safety effects at the aircraft level. Additionally, limit the Special Conditions to testing and installation of “Large” Battery Systems absent evidence of safety concerns for batteries smaller than this.	Conceptual	Noted - The intent of this AC is to cover all installed rechargeable lithium battery and battery systems on aircraft. The AC attempts to incorporate risk-based decision making.
184	Garmin	Page D-1	Appendix D Special Condition Requirement #3		Specifies a requirement that “The battery system shall not emit any explosive or toxic gases, smoke, or fluids during normal operation except through designed venting provisions.” The FAA provides no explanation as to how to quantify what constitutes “hazardous quantities” of “explosive or toxic gases, smoke, or fluids” that must lead to the use of “designed venting provisions”. Transport aircraft are operated every day with hundreds of personal devices that include lithium batteries in the cabin area. Pilots of transport and GA aircraft also have personal devices in the cockpit in the form of tablet and laptop computers, cell phones, etc. that use lithium batteries.	The FAA needs to determine at what size a lithium battery can release “hazardous quantities” of “explosive or toxic gases, smoke, or fluids” that must lead to the use of “designed venting provisions”. The FAA has already made at least an implied determination that some lithium batteries do not require venting because of the many personal devices that are allowed in both the cockpit and the cabin. This determination needs to be extended across the range of battery sizes.	Conceptual	Agree with modification - Appendix E, Special Condition #3, reference to DO-347 section 1.6.2 modified to state, “Venting Provisions. For a Small/Medium battery, it is acceptable to vent into the surrounding battery container if meeting the provisions of this section.”

For detailed instructions on how to fill out the columns below, please see the Instructions sheet.

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185	Garmin	Page D-1 and D-2	Appendix D Special Condition Requirement #1, #2 and #3		Includes the statements “The probability of this failure must be shown to be extremely remote (1 event in 10 million (1x10-7) flight hours)” and “The probability of impact must be extremely improbable (1 event in 1 billion ($1x10^{-9}$) flight hours).” The extremely remote 1x10-7/flight hour and extremely improbable 1x10-9/flight hour failure probabilities equate to Hazardous and Catastrophic failure classifications, which are inconsistent with the TSO-C179a paragraph 3.b Failure Condition Classification which states (bold and italics in original) “Failure of the function defined in paragraphs **3** and **3a** of this TSO is a *major* failure condition.” The FAA provides no justification for the change in failure classification. Transport aircraft are operated every day with hundreds of personal devices that include lithium batteries in the cabin area. Pilots of transport and GA aircraft also have personal devices in the cockpit in the form of tablet and laptop computers, cell phones, etc. that use lithium batteries.	The FAA needs to determine at what size a lithium battery can realistically have a catastrophic vs. hazardous vs. major vs. minor vs. no safety effect. The FAA has already made at least an implied determination that some lithium batteries have no safety effect on the aircraft because of the many personal devices that are allowed in both the cockpit and the cabin. This determination needs to be extended across the range of battery sizes. The FAA also needs to extend this failure classification determination to TSO-C179a as the “one size fits all” failure classification has not been applied in existing practice.	Conceptual	Disagree - This evaluation depends on the installation specifics and is determined by the ACO during installation. The TSO is out of scope of this document. It will be dealt with at the TSO level and not this AC.
186	Garmin	Page G-1	Appendix G Notes I. and III.		The use of the term “conformed” in these notes does not consider that the laboratory testing may have been performed under a TSO process, where FAA conformity is not required.	Change “FAA conformed and successfully tested…” to “successfully tested under an FAA approved process…” in both Notes.		Disagree - FAA conformity is required for installation compliance.

For detailed instructions on how to fill out the columns below, please see the Instructions sheet.

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187	Garmin	Page G-1	Appendix G Flowchart, Note I, Note II, and Note VI.		According to the flowchart, Note VI states any equipment containing rechargeable lithium batteries must: "…be evaluated for installation requirements. If the equipment has a TSO, the tests under the TSO MOPS can be used for compliance to the airworthiness regulations (Test Report must be provided). When there is a delta between the test accomplished under the TSO and the installation requirement based on criticality and location on aircraft only the delta tests, if any, need to be tested in order to comply with the airworthiness regulations." This AC requires the use of DO-311, DO‑347, DO-160, DO-178, and DO-254, but no TSO requires the use of all five standards. The "Delta Tests" that would be necessary to comply with this AC's MOC seems to violate the intent of using TSO‑179a for rechargeable lithium batteries. TSO‑179a only requires the use of DO-311, DO-178B, and DO-254; the TSO-C179a paragraph 3.d that normally references DO-160 instead refers back to DO-311 and no TSO refers to DO-347.	This AC needs to clearly state when TSO minimum performance standards are acceptable and coordinate the AC to all other applicable FAA standards and guidance, such as TSO-C179a. This AC's MOC amplifies the requirements for rechargeable lithium batteries with no clear definition of what regulations are being satisfied.	Conceptual	Disagree - The Appendix G flowchart Note I states "*appropriate standards* [emphasis added] such as DO-311, DO‑347, DO-160, DO-178, and DO-254 (or equivalent)." TSOA does not guarantee installation approval, as that decision lies with the project ACO.
188	Garmin				If a battery is compliant with the minimum performance standards of TSO-C179a, is it required to meet all Deltas from that of Appendix E and F, which both include DO-347 sections? DO-347 is clearly not required by TSO-C179a. Note I references the same five standards and Note II references TSO-C179a.			